THE

SILVA OF NORTH AMERICA

BY

CHARLES SPRAGUE SARGENT

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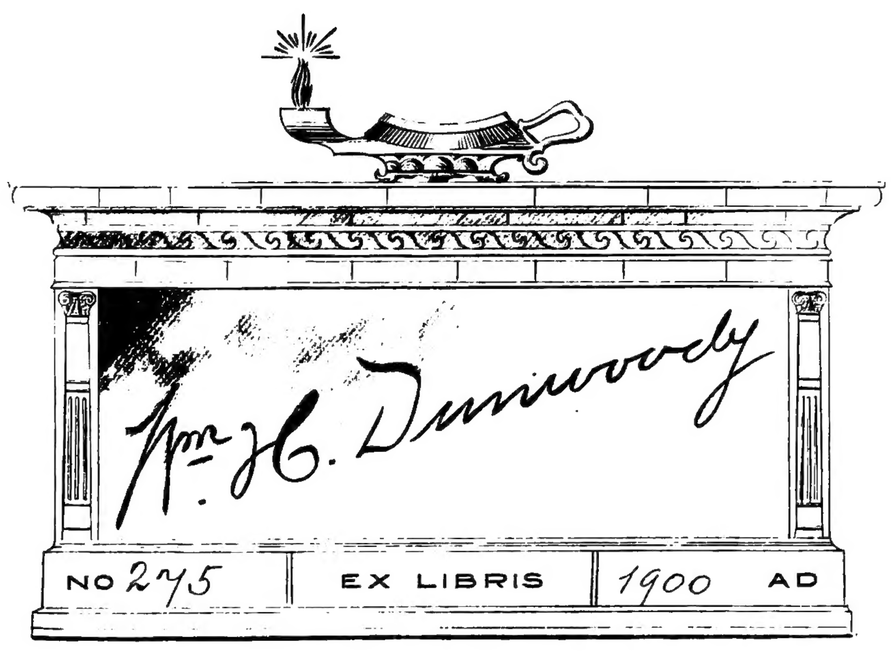

THE

SILVA OF NORTH AMERICA

A DESCRIPTION OF THE TREES WHICH GROW NATURALLY IN NORTH AMERICA EXCLUSIVE OF MEXICO

BY

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OF HARVARD UNIVERSITY

Illustrated with Figures and Analyses drawn from Nature

BY

CHARLES EDWARD FAXON

VOLUME XI

CONIFERÆ

(Pinus)

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TO

JOHN MUIR

LOVER AND INTERPRETER OF NATURE

WHO BEST HAS TOLD THE STORY OF THE SIERRA FORESTS

THIS ELEVENTH VOLUME OF

THE SILVA OF NORTH AMERICA

IS GRATEFULLY DEDICATED

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SYNOPSIS OF THE ORDERS OF PLANTS CONTAINED IN VOLUME XI. OF THE SILVA OF NORTH AMERICA.

CLASS III. **GYMNOSPERMÆ. Resinous trees or shrubs.**

Stems increasing in diameter by the annual addition of a layer of wood inside the bark. Flowers unisexual, naked. Stamens numerous. Ovules 2 or many not inclosed in an ovary. Cotyledons 2 or more. Leaves usually straight-veined, persistent, or deciduous.

58. **Coniferæ.** Flowers monœcious, usually solitary, terminal, or axillary. Ovules 2 or many. Fruit a woody or rarely fleshy strobile. Cotyledons 2 or many. Leaves scale-like, linear or subulate, solitary or clustered.

SILVA OF NORTH AMERICA.

PINUS.

Flowers naked, monœcious, the staminate involucrate, fascicled; stamens indefinite, anther-cells 2; the pistillate lateral or subterminal, solitary or clustered, their scales spirally disposed; ovules 2 under each scale. Fruit a woody strobile maturing in two or rarely in three years. Leaves dimorphic, the primordial scattered, the secondary fascicled, persistent.

Pinus, Duhamel, *Traité des Arbres*, ii. 121 (1755). — Adanson, *Fam. Pl.* ii. 480. — Link, *Abhand. Akad. Berl.* 1827, 157. — Bentham & Hooker, *Gen.* iii. 438. — Engelmann, *Trans. St. Louis Acad.* iv. 161. — Eichler, *Engler & Prantl Pflanzenfam.* ii. pt. i. 70. — Masters, *Jour. Linn. Soc.* xxx. 37.

Pinus, Linnæus, *Gen.* 293 (in part) (1737). — Endlicher, *Gen.* 260 (in part). — Meisner, *Gen.* 352 (in part). — Baillon, *Hist. Pl.* xii. 44 (in part).

Apinus, Necker, *Elem. Bot.* iii. 269 (1790).

Cembra, Opiz, *Seznam*, 27 (1852).

Strobus, Opiz, *Lotos*, iv. 94 (1854).

Trees, or rarely shrubs, with deeply furrowed and sometimes laminate or with thin and scaly bark, hard or soft heartwood often conspicuously marked by dark bands of summer cells impregnated with resin, pale nearly white sapwood, stout branches and branchlets, large terminal and axillary branch-buds formed during summer and covered with numerous loosely imbricated scarious usually chestnut-brown thin ovate acute accrescent scales, the outer empty and persistent on the growing branch, the inner inclosing the leaf-buds,[1] and fibrous rootlets. Primary leaves subulate from a broad base, flat, keeled above and below, usually serrulate, stomatiferous on both surfaces, scarious or hyaline, marcescent, spirally disposed in many series, on some species occasionally produced on vigorous stump shoots and branches;[2] secondary or foliage leaves clustered, the clusters borne on rudimentary branches in the axils of primary leaves or of bud-scales, and surrounded at the base by sheaths of two lateral keeled scales and from six to ten inner accrescent scales more or less united by their thin edges, inclosing the leaf-clusters in the bud, persistent with the leaves, or loose, spreading, and deciduous during the first season; leaf-clusters composed of two, three, or five, or rarely of six or seven leaves, or of a single leaf, the number usually definite in each species, or on a few species regularly variable, deciduous during their second season or persistent for many years; leaves acicular, elongated, acute, spinescent, or occasionally somewhat obtuse and entire at the apex, generally sharply serrulate on the margins and on the keel of the upper surface; in two-leaved clusters, semiterete, convex below, flat above, in clusters of three or more, triangular and more or less keeled above, or terete when solitary; stomatiferous, the stomata disposed in longitudinal bands on one or on both surfaces; fibro-vascular bundles solitary or in pairs; resin ducts peripheral or parenchymatous or internal, often varying in number in the same species; hypoderm or strengthening cells scattered under the epidermis, usually at the angles and keel of the leaf, and occasionally also in the fibro-vascular region. Flowers

monœcious, very rarely androgynous,[3] appearing in early spring. Staminate flowers fascicled at the base of leafy accrescent shoots of the year in the axils of bracts, yellow, orange-color, or scarlet, oval, cylindrical, or more or less elongated, composed of numerous sessile two-celled anthers imbricated in many ranks, their cells parallel, extrorse, opening on the sides longitudinally and surmounted by crest-like transverse semiorbicular or almost orbicular connectives, entire, denticulate, lacerate, or rarely short and tuberculate or dentate, each flower surrounded at the base by an involucre of scale-like bracts varying from three to sixteen, usually definite in number on each species, the two external bracts lateral, strongly keeled on the back; pollen-grains bilobed, with lateral air sacs.[4] Pistillate flowers subterminal or lateral, solitary, geminate, or clustered, erect or recurved, sessile or pedunculate, borne near the apex of branchlets of the year in the axils of bud-scales, composed of numerous carpellary scales each in the axil of a small bract, spirally disposed in many series, rounded, obtuse and appressed at the apex, or produced into longer or shorter or much elongated subulate often scarious tips, bearing on the inner surface near the base two naked collateral inverted ovules. Fruit a woody pendulous horizontal, or occasionally erect, subglobose oblong or elongated conical symmetrical or, by the greater development of the scales on one side than on the other, oblique woody strobile maturing at the end of the second or rarely of the third season, and persistent on the branch after the escape of the seeds, or on some species remaining closed for many years, composed of the now hard and woody scales of the flower more or less thickened on the free exposed surface terminating in a blunt umbo or acicular with a weak or strong caducous or stout persistent mucro, or furnished with a much thickened elongated often curved or twisted spine;[5] floral bracts now thickened and corky, much shorter than the scales, partly inclosing the seeds in depressions at the base. Seeds geminate, reversed, attached at the base in shallow depressions on the inner face of the scales, obovate or obliquely triangular, occasionally nearly cylindrical, often somewhat compressed, smooth or frequently slightly ridged or tuberculate below, destitute of resin vescicles, in falling bearing away portions of the membranaceous lining of the scale forming wing-like attachments often several times longer or as long or shorter than the seeds, or reduced to a narrow rim frequently remaining attached to the scale after the falling of the seed; testa of two coats, the outer crustaceous, or thick, hard, and bony, pale gray, yellow-brown, or black, sometimes produced into a narrow wing-like border, the inner membranaceous, light chestnut-brown, and lustrous. Embryo axile in copious fleshy albumen; cotyledons from three to fifteen or rarely eighteen,[6] usually much shorter than the inferior radicle.[7]

About seventy species of Pinus can now be distinguished.[8] The genus is widely distributed through the northern hemisphere from the Arctic Circle to the West Indies[9] and the highlands of Central America[10] in the New World, and in the Old World to the Canary Islands, which are inhabited by one endemic species,[11] northern Africa, Burma, and the Philippine Islands, where one species occurs,[12] and to the mountains of the Indian Archipelago, where a single species crosses the equator.[13] Pine-trees form vast forests on high mountain slopes and maritime plains, and are generally scattered through the forests of deciduous-leaved trees in most northern countries. The principal centres of distribution of Pinus are the western United States, where twenty-one species are recognized, the eastern United States, where thirteen species grow, and the highlands of Mexico, which are often covered with great forests of Pine-trees.[14] In the Old World Pine-trees abound in the regions bordering the Mediterranean, where there are five species, and constitute great forests on the mountains of central Europe and the plains of northern Europe and Asia. In southern Asia the genus is comparatively poorly represented in number of species, although on some of the outer ranges of the Himalayas the forests are largely composed of Pine-trees.[15] It is widely distributed with a few species through eastern continental Asia,[16] and Pine-trees are common in all the elevated regions of Japan.[17] The genus has representatives in all parts of eastern North America except the basin of the central Mississippi and the elevated plains east of the Rocky Mountains; in the north one species only braves the arctic winter; four inhabit the St. Lawrence basin and northern New England; the number increases to five

in the middle Atlantic states, and in the lowlands of the south eight species are found. In western North America Pine-trees are distributed over all the mountain ranges and elevated valleys from Alaska to the Mexican boundary, which is crossed by five Mexican species finding their northern home on the mountains of southern California, Arizona, and New Mexico. At the north Pine-trees form great forests on many of the interior ranges of the Pacific states, and at the south, mingled with Junipers, frequently cover elevated plains and mesas; they are found at the timber line on all high mountains, maintaining a foothold where no other tree can live; they bear uninjured the fiercest ocean gales, and flourish in the arid valleys of the interior, where neither cold nor drought is able to check their vigor.

The type is an ancient one. Represented by a few species in the cretaceous flora of North America and Europe, it became abundant in the miocene period, when at least one hundred species of Pines are believed to have existed.[18]

Pinus contains some of the most important timber-trees of the world; and the straight-grained moderately hard resinous wood of many species is used in immense quantities. The most valuable timber-trees of the genus are the eastern American *Pinus palustris*, *Pinus Strobus*, and *Pinus echinata*, the western American *Pinus Lambertiana*, *Pinus ponderosa*, and *Pinus monticola*, the tropical American *Pinus heterophylla*, *Pinus sylvestris*[19] of northern Europe and Asia, *Pinus Laricio*[20] of southern Europe, the Himalayan *Pinus Nepalensis*,[21] and the eastern Asiatic *Pinus Thunbergii*[22] and *Pinus densiflora*.[23] Resin from which turpentine is distilled is obtained by drawing off the juices of several species, the largest part of the world's supply being obtained from the eastern American *Pinus palustris* and *Pinus heterophylla;* it is also obtained from *Pinus Pinaster*[24] and *Pinus Halepensis*[25] of the Mediterranean basin, and from the Himalayan *Pinus Roxburghii*.[26] Tar[27] is manufactured by the slow combustion of the wood of Pines and other conifers. Oil of turpentine[28] and other products distilled from the resins of several species of Pinus are stimulant, diuretic, and anthelmintic, and are employed in the treatment of human diseases,[29] and for illuminating purposes. Rosin, the residue left from the distillation of turpentine from resin, is used in plasters, and in the manufacture of soap, sealing-wax, varnish, and cement;[30] and an essential oil used medicinally is distilled from the leaves and young shoots of different Pine-trees.[31] The large slightly resinous edible seeds of several species are important articles of human food, the best being produced by the Nut Pines of western North America, by *Pinus Pinea*[32] of the Mediterranean region, *Pinus Cembra*[33] of Europe and Asia, and *Pinus Gerardiana*[34] of northwestern India. Pine wool, a coarse fibre manufactured from the leaves of *Pinus Laricio*, *Pinus sylvestris*, and other European species, is used to stuff mattresses and cushions, and, woven with animal wool, is made into hospital and military blankets and into underclothing which is believed to possess valuable medical properties.[35] In the southern United States coarse carpets are woven from the leaves of *Pinus palustris*.[36] In China different species of Pinus are used in medicine.[37] The bark of several species contains sufficient tannic acid to make them valuable for tanning leather, and in the Old World Pine-bark is occasionally employed for this purpose.[38]

The cultivation of Pine-trees for the production of timber has long occupied the attention of Japanese[39] and European silviculturists; and Pine-trees are used to decorate the parks and gardens of all temperate countries.

In the United States Pinus is preyed on by many insects,[40] and is attacked by numerous fungal diseases.[41]

Pine-trees can be easily raised from seeds, which, however, must not be allowed to become dry, as they soon lose their vitality. Easily transplanted while young, their long fibrous rootlets do not hold the soil firmly when disturbed, and make the operation of moving large plants difficult and uncertain.

The classical name of the Pine-tree was adopted by Tournefort[42] for this genus as it is now limited.

[1] Henry, *Nov. Act. Acad. Cæs. Leop.* xix. 93, t. 12; xxii. pt. i. 247, t. 23.

[2] *Pinus rigida* and *Pinus echinata* are the species of the United States which generally bear primary leaves on branches, or produce freely shoots from the stumps of cut trees. These shoots, which are clothed with primary leaves, grow vigorously for a few years and then usually perish. On the sandy sterile plains in Burlington and Ocean Counties, New Jersey, however, the coppice growth over large areas is principally composed of such stump shoots. They are usually destroyed at the end of a few years by fires which do not kill the stumps; and these often live to a great age, producing successive crops of shoots, and show the wonderful recuperative power of these trees under what would seem to be most unfavorable conditions. (See Fernow, *Garden and Forest*, viii. 472; x. 209.)

[3] Near Bluffton, South Carolina, Dr. J. H. Mellichamp has noticed two trees of *Pinus heterophylla* producing during several successive seasons well developed pistillate flowers at the tips of the staminate flowers (Christ, *Bull. Soc. Bot. Belg.* xxxiii. pt. ii. 88. — J. G. Jack, *Garden and Forest*, viii. 222, f. 33, 2).

[4] The pollen of Pinus can float in the air for a long time, and is sometimes wafted great distances by the wind. Engelmann (*Trans. St. Louis Acad.* iv. 169) found after a southern storm in March Pine pollen in the streets of St. Louis which must have been carried from the forests of *Pinus palustris* on the Red River, a distance of four hundred miles in a direct line; and the decks of vessels off the coast of the south Atlantic states are sometimes covered with Pine pollen in early spring.

[5] According to Celakovsky, the umbo of the cone-scale of Pinus is the apophysis of the scale of the first year, which becomes woody and ceases to grow at the end of the first season, the apophysis of the mature cone being developed the second year from tissue at the base of the umbo (*Oesterr. Bot. Zeitschr.* 1893, 314, t. 14, f. 11–14).

[6] In germinating the empty hood-like testa of the Pine seed from which the wing has usually fallen is raised on the tip of the cotyledons; the axis soon commences to elongate and to bear primary leaves from whose axils the clusters of foliage leaves begin to appear in the second season, although in the case of *Pinus palustris* of the southeastern United States, as noticed by Engelmann, the axes during six or eight years thicken without elongating and bear in the axils of the primary leaves numerous clusters of long secondary leaves (*l. c.* 174).

[7] By Engelmann (*l. c.* 175) the species of Pinus are grouped in the following sections, his arrangement being based on the form of the cone-scales, the internal structure of the leaves, and the position of the cones: —

Sect. 1. STROBUS. Cones subterminal; exposed part of the cone-scales thin, rarely reflexed, furnished with a marginal unarmed umbo. Leaves in 5-leaved clusters, the sheaths loose and deciduous. Anthers terminating in a knob, in a few teeth, or in a short crest. Wood soft and light-colored. White Pines.

EUSTROBI. Leaves sharply serrulate or rarely nearly entire; resin ducts peripheral. Inhabitants of eastern and western North America, Mexico, Japan, the Himalayas, and southeastern Europe.

CEMBRÆ. Leaves sparingly serrulate; resin ducts parenchymatous. Inhabitants of northeastern and northern Asia and central Europe.

Sect. 2. PINASTER. Exposed portion of the cone-scales thickened, the dorsal umbo usually aristate. Leaves in from 1 to 5-leaved clusters, the sheaths usually persistent. Anthers generally terminating in semiorbicular or nearly orbicular crests. Wood hard, heavy, and resinous. Pitch Pines.

INTEGRIFOLIÆ. Cones subterminal, their scales thick, unarmed or in one species furnished with long slender awns. Leaves in from 1 to 5-leaved clusters, entire; resin ducts peripheral. Anthers terminating in a knob or in a few teeth. Inhabitants of western North America and of northern Mexico.

SYLVESTRES. Cones subterminal. Leaves in 2 or 3-leaved clusters, serrulate, the sheaths persistent; resin ducts peripheral. Anthers crested or in one species knobbed. Inhabitants of Europe, southeastern Asia, the Philippine Islands, and eastern North America.

HALEPENSES. Cones lateral, their scales much thickened with prominent umbos or smooth. Leaves in 2 or 3-leaved clusters, the sheaths deciduous or persistent; resin ducts peripheral. Inhabitants of northern China, the northwest Himalayas, and the basin of the Mediterranean.

PONDEROSÆ. Cones subterminal, their scales umbonate. Leaves in 2, 3, or 5-leaved clusters, the sheaths persistent or deciduous; resin ducts parenchymatous. Inhabitants of western North America, Mexico, the Canary Islands, southern Europe, and Japan.

TÆDÆ. Cones lateral, their scales much thickened, and armed with stout and persistent or with weak deciduous prickles or with stout elongated hooked or twisted spines. Leaves in 2 or 3-leaved clusters, the sheaths persistent; resin ducts parenchymatous. Inhabitants of eastern and western North America, Mexico, and southern Europe.

AUSTRALES. Cones subterminal or lateral, their scales umbonate. Leaves in from 2 to 5-leaved clusters, the sheaths deciduous; resin ducts internal. Inhabitants of southeastern North America, the West Indies, and Mexico.

[8] Parlatore, *De Candolle Prodr.* xvi. pt. ii. 378. — Engelmann, *l. c.* 175.

A tendency to hybridize has not been observed in the North American species of Pinus; but in Europe supposed hybrids between *Pinus sylvestris* and *Pinus montana* have been noticed in the Swiss Engadine (see Christ, *Flora*, xlvii. 145, t. 1. — Beissner, *Handb. Nadelh.* 230); and Mayr found in Japan what he believed to be hybrids between *Pinus Thunbergii* and *Pinus densiflora* (*Monog. Abiet. Jap.* 83, t. 7, f. 2, 3, 4; 84, t. 7, f. 3, 4).

[9] A. Richard, *Fl. Cub.* iii. 233. — Grisebach, *Cat. Pl. Cub.* 217. — Sauvalle, *Fl. Cub.* 151.

[10] Morris, *The Colony of British Honduras*, 56.

[11] *Pinus Canariensis*, Buch, *Phys. Beschr. Canar. Ins.* 159 (1825). — De Candolle, *Pl. Rar. Jard. Genève*, 1, t. 1, 2. — D. Don, *Lambert Pinus*, iii. t. — Webb & Berthelot, *Phytogr. Canar.* sect. iii. 280; Atlas, t. 6. — Forbes, *Pinetum Woburn.* 57, t. 21. — Link, *Linnæa*, xv. 508. — Antoine, *Conif.* 33, t. 15. — Endlicher, *Syn. Conif.* 165. — Carrière, *Traité Conif.* 348. — Gordon, *Pinetum*, 191. — Parlatore, *l. c.* 393. — Christ, *Bot. Jahrb.* ix. 172, 486 (*Spicilegium Canar.*). — Masters, *Gard. Chron.* ser. 3, iii. 723, f. 94.

Pinus Canariensis inhabits the mountains of Teneriffe, and at elevations of from five to six thousand feet above the sea forms extensive forests on Grand Canary Island. It is a tree seventy or eighty feet in height, with a stout trunk covered by thick deeply furrowed bark, a broad round-topped head of spreading branches, slender dark green leaves in clusters of three and from eight to ten inches in length, and oblong-ovate lustrous cones. It grows with great rapidity while young, and has been largely planted in the gardens of southern Europe and other warm countries.

[12] *Pinus insularis*, Endlicher, *Syn. Conif.* 157 (1847). — Carrière, *Traité Conif.* 353. — Parlatore, *De Candolle Prodr.* xvi. pt. ii. 390. — Vidal y Soler, *Sin. Pl. Leñ. Filipinas*, t. 98 f. C.

Pinus Tœda, Blanco, *Fl. Filip.* 767 (not Linnæus) (1837).

Pinus Timoriensis, Loudon, *Arb. Brit.* iv. 2269 (1838).

Pinus insularis, which is still imperfectly known, is described as a large tree, with slender dark green leaves in clusters of three and from six to nine inches in length, and small ovate obtuse cones.

[13] *Pinus Merkusii*, De Vriese, *Pl. Nov. Ind. Bat.* 5, t. 2 (1845). — Endlicher, *l. c.* 176. — Miquel, *Pl. Jungh.* i. 1; *Fl. Ind. Bat.* ii. 1069; Suppl. 252, 588. — Carrière, *l. c.* 380. — Gordon, *Pinetum*, 169. — De Boer, *Conif. Archip. Ind.* 5. — Parlatore, *l. c.* 389. — Kurz, *Forest Fl. Brit. Burm.* ii. 499. — Vidal y Soler, *l. c.* t. 98, f. B.

Pinus sylvestris, Willdenow, *Loureiro Fl. Cochin.* ed. 2, ii. 709 (not Linnæus) (1793).

Pinus Finlaysoniana, Blume, *Rumphia*, iii. 210 (1837).

Pinus Latteri, Mason, *Jour. As. Soc. Beng.* i. 74 (1849).

Pinus Merkusii, which is widely distributed through the Malay Peninsula and over the high mountains of the Indian Archipelago, is closely related to and perhaps only a geographical form of the south China and Malayan *Pinus Massoniana*, Lambert. It is a tree which is often more than a hundred feet in height, with very slender leaves in clusters of two and from eight to ten inches in length, and small ovate acute cones.

[14] Hemsley, *Bot. Biol. Am. Cent.* iii. 186.

Great confusion still exists with regard to the specific characters and distribution of the Pines of Mexico, which can claim perhaps twelve or fourteen species. This confusion has been greatly increased by seed collectors, who have distributed seeds of these trees under different names, Roezl alone having described, and distributed the seeds of, ninety-two species of Mexican Pines (see *Catalogue des Graines de Conifères Mexicains en vente chez B. Roezl et Cie, Horticultures à Napoles près Mexico pour automne* 1857 *et printemps* 1858, 10); and it will probably never be cleared up until these trees have been specially studied in their native forests by competent observers.

[15] Brandis, *Forest Fl. Brit. Ind.* 505. — Kurz, *l. c.* 498. — Hooker f. *Fl. Brit. Ind.* v. 651.

[16] Masters, *Jour. Linn. Soc.* xviii. 503 (*Conifers of Japan*). — Franchet, *Nouv. Arch. Mus.* sér. 2, v. 285 (*Pl. David.* i.).

[17] Siebold & Zuccarini, *Abhand. Akad. Münch.* iv. pt. iii. 235. — A. Murray, *The Firs and Pines of Japan*, 5. — Franchet & Savatier, *Enum. Pl. Jap.* i. 464. — Masters, *l. c.* — Mayr, *Monog. Abiet. Jap.* 67.

[18] Lesquereux, *Rep. U. S. Geolog. Surv.* vii. 72, 83, t. 7, f. 25–33. — Saporta, *Origine Paléontologique des Arbres*, 60. — Zittel, *Handb. Palæontolog.* ii. 337.

[19] Linnæus, *Spec.* 1000 (excl. var.) (1753). — Lambert, *Pinus*, i. 1, t. 1. — Willdenow, *Spec.* iv. pt. i. 494. — De Candolle, *Lamarck Fl. Franç.* ed. 3, iii. 271. — *Nouveau Duhamel*, v. 230, t. 66. — Brotero, *Hist. Nat. Pinheiros, Larices e Abetos*, 6. — Link, *Abhand. Akad. Berl.* 1827, 165; *Linnœa*, xv. 484. — Ledebour, *Fl. Alt.* iv. 199; *Fl. Ross.* iii. 674. — Forbes, *Pinetum Woburn.* 7. — Antoine, *Conif.* 9, t. 4, f. 3. — Spach, *Hist. Vég.* xi. 376. — Visiani, *Fl. Dalm.* i. 199. — Schouw, *Ann. Sci. Nat.* sér. 3, iii. 231 (*Conifères d'Italie*). — Endlicher, *l. c.* 171. — Hartig, *Forst. Culturpfl. Deutschl.* 53, t. 4. — Reichenbach, *Icon. Fl. German.* xi. 1, t. 521. — Carrière, *l. c.* 372. — Turczaninow, *Fl. Baicalensi-Dahurica*, ii. 142. — Koch, *Syn. Fl. German.* ed. 3, ii. 576. — Maximowicz, *Mém. Sav. Étr. Acad. Sci. St. Pétersbourg*, ix. 263 (*Prim. Fl. Amur.*). — Willkomm & Lange, *Prodr. Fl. Hispan.* i. 17. — Tchihatcheff, *Asie Mineur*, iii. pt. ii. 497. — Parlatore, *Fl. Ital.* iv. 46; *De Candolle Prodr. l. c.* 385. — K. Koch, *Dendr.* ii. pt. ii. 273. — Masters, *l. c.* 505. — Laguna, *Coníferas y Amentáceas Españolas*, 28; *Fl. Forestal Española*, i. 60, t. 6. — Boissier, *Fl. Orient.* v. 694. — Schübeler, *Virid. Norveg.* i. 375, f. 58–64. — Hempel & Wilhelm, *Bäume und Sträucher*, i. 120, f. 58–67. — Beissner, *Handb. Nadelh.* 225, f. 57, 58.

Pinus rubra, Miller, *Dict.* ed. 8, No. 3 (1768). — *Nouveau Duhamel*, v. 233, t. 67, f. 1. — De Candolle, *l. c.* 272.

Pinus Tartarica, Miller, *l. c.* No. 4 (1768).

Pinus Mugo, Turra, *Fl. Ital. Prodr.* 67 (1780).

Pinus montana, G. F. Hoffmann, *Deutschl. Fl.* 340 (not Miller) (1791).

Pinus binato-folio, Gilibert, *Exercit. Phyt.* ii. 414 (1792).

Pinus borealis, Salisbury, *Prodr.* 398 (1796).

Pinus resinosa, Savi, *Fl. Pis.* ii. 354 (not Aiton) (1798).

Pinus humilis, Link, *Abhand. Akad. Berl.* 1827, 170 (1830).

Pinus Armena, K. Koch, *Linnœa*, xxii. 297 (1849).

Pinus Pontica, K. Koch. *l. c.* (1849).

Pinus Frieseana, Wichura, *Flora*, xlii. 409 (1859).

Pinus sylvestris, which is usually known to English-speaking people as the Scotch Fir, the Scotch Pine, or the Riga Pine, attains under favorable conditions a height of one hundred and fifty feet, and produces a trunk three or four feet in diameter, free of branches for seventy or eighty feet, and clothed, except at the base, with red scaly bark, a comparatively narrow open round-topped head of small branches, stout rigid bluish or grayish green leaves in clusters of two and from an inch and a half to two inches and a half in length, and broadly ovate cones from an inch to an inch and a quarter long. It is widely distributed through Europe and Russian Asia from the Arctic Circle to the Sierra Nevada of southern Spain, central Italy, Dalmatia, Asia Minor, and northern Persia, and from the shores of the Atlantic Ocean to the valley of the Amoor River, forming in northern Europe and Siberia vast forests on sandy plains and at the south covering mountain slopes, which it sometimes ascends to elevations of from six to seven thousand feet above the level of the sea. *Pinus sylvestris* is the principal timber Pine of Europe and Asiatic Russia, and its wood is of great commercial importance in all the countries of northern Europe, whence it is exported in large quantities. When produced under the best conditions the wood is light, elastic, strong, and durable; it is used for the masts of vessels, in all sorts of construction, for railway-ties, and for fuel. It differs, however, greatly in quality, and European silviculturists have carefully studied these variations of the wood of *Pinus sylvestris* in connection with variations in its external characters, and have distinguished a number of geographical forms which are rather nominal than real, it being now well understood that the character of the wood depends on the climate and soil of the region where it is produced rather than on any modifications in habit, foliage, or organs of reproduction. (See, for the races of *Pinus sylvestris*, Don, *Mem. Caledonian Hort. Soc.* i. 121. — Delamarre, *Traité Pratique de la Culture des Pins*, 23. — Loudon, *Arb. Brit.* iv. 2455. — L. Vilmorin, *Mém. Soc. d'Agric.* 1863, pt. i. 297 [*Exposé Historique et Descriptif de l'École Forestière des Barres*].)

In some of the countries of northern Europe resin is obtained from *Pinus sylvestris*, and tar is also manufactured from its wood in great quantities (Clarke, *Travels*, ed. 4, xi. 299). The inner bark and the branchlets are used to feed cattle and hogs; in time of famine the bark serves in the extreme north as human food (Clarke, *l. c.* 528); and the outer bark is employed to thatch houses.

Pinus sylvestris was introduced into the United States early in

the present century and has been largely planted in the northern states as an ornamental tree, and to make wind-breaks on the prairies and plains of the central west. Extremely hardy in the northern states and in Canada, it grows here while young with great rapidity, but soon succumbs to disease and the attacks of boring insects, and rarely lives more than thirty or forty years. In Europe *Pinus sylvestris* has been much used in the decoration of parks, and a number of abnormal forms are distinguished and propagated by gardeners. (See Hoopes, *Evergreens*, 104. — Beissner, *Handb. Nadelh.* 225.)

[20] Poiret, *Lamarck Dict.* v. 339 (1804). — De Candolle, *Lamarck Fl. Franç.* ed. 3, iii. 274. — Link, *Abhand. Akad. Berl.* 1827, 174; *Linnæa*, xv. 494. — Lambert, *Pinus*, ed. 2, i. t. 4. — Forbes, *Pinetum Woburn.* 23. — Antoine, *Conif.* 3, t. 1, f. 1–3. — Spach, *Hist. Vég.* xi. 384 (excl. var. γ). — Schouw, *Ann. Sci. Nat.* sér. 3, iii. 234 (*Conifères d'Italie*). — Endlicher, *Syn. Conif.* 178. — Reichenbach, *Icon. Fl. German.* xi. 2, t. 524. — Carrière, *Traité Conif.* 384. — Gordon, *Pinetum*, 168. — Willkomm & Lange, *Prodr. Fl. Hispan.* i. 18. — Parlatore, *Fl. Ital.* iv. 52; *De Candolle Prodr.* xvi. pt. ii. 386. — Laguna, *Coniferas y Amentáceas Españolas*, 28; *Fl. Forestal Española*, i. 77, t. 8. — Beissner, *l. c.* 238.

Pinus sylvestris, ϵ *maritima*, Aiton, *Hort. Kew.* iii. 366 (1789).

Pinus maritima, Aiton, *l. c.* ed. 2, v. 315 (not Miller) (1813).

Pinus Pinaster, Moris, *Stirp. Sard. Elench.* i. 42 (not Aiton) (1827).

Pinus Laricio is a tree frequently one hundred feet in height, with slender dark green often twisted leaves in clusters of two and from four to six inches in length, and ovate cones solitary or in pairs and three or four inches long. It covers with its several varieties many of the mountain ranges of southern Europe and of Asia Minor, forming vast but usually isolated forests from the Pyrenees to the Taurus. The wood of this tree is hard and strong, and is valued for all sorts of construction, although the abundance of its resinous secretions detracts from its value for masts for vessels and material for the interior finish of buildings. *Pinus Laricio* first attracted the attention of European silviculturists in the middle of the last century, and has been largely cultivated in France, southern Germany, and Great Britain (Loudon, *Arb. Brit.* iv. 2200). The attempts which have been made to introduce it into the United States have usually been unsuccessful, and in New England its southern forms are not generally hardy.

The Austrian Pine, a native of the mountains of southern Austria, Servia, and Roumania, is now usually considered a geographical variety of *Pinus Laricio*. It is: —

Pinus Laricio, β *Austriaca*, Endlicher, *l. c.* 179 (1847). — Hempel & Wilhelm, *Bäume und Sträucher*, i. 148, f. 74–78, t. 6.

Pinus Pinaster, Besser, *Fl. Gal.* ii. 294 (not Aiton) (1809).

Pinus sylvestris, Baumgarten, *Enum. Stirp. Transs.* ii. 304 (not Linnæus) (1816).

Pinus Austriaca, Höss, *Anleit.* 6 (1830); *Monog. der Schwarzföhre.* — De Chambray, *Traité Arb. Rés. Conif.* 327, t. 3, f. 13–15, t. 5, f. 6, 7. — Hartig, *Forst. Culturpfl. Deutschl.* 74, t. 6. — Carrière, *l. c.* 387. — Gordon, *l. c.* 162.

Pinus nigra, Link, *Abhand. Akad. Berl.* 1827, 173 (not Aiton) (1830).

Pinus nigricans, Host, *Fl. Austr.* ii. 628 (1831). — Tenore, *Fl. Nap.* v. 139. — Link, *Linnæa*, xv. 491.

Pinus maritima, Koch, *Syn. Fl. German.* 667 (not Miller) (1837).

Pinus Laricio, Koch, *l. c.* ed. 2, 767 (not Poiret) (1843).

Pinus Laricio, β *nigricans*, Parlatore, *Fl. Ital.* iv. 53 (1867); *De Candolle Prodr.* xvi. pt. ii. 387.

The Austrian Pine, which differs from the typical *Pinus Laricio* of Corsica in its shorter, stouter, and more rigid leaves, grows on plains and low mountain slopes, flourishing on limestone soil, rapidly attaining a large size, and producing strong coarse-grained resinous wood useful for all sorts of rough construction. The rapid growth of this tree, its shapely habit while young, and the denseness of its dark foliage, have made it a favorite for the decoration of parks, and it has been largely planted in northern and central Europe and in the northern United States. In America, however, it suffers early from boring insects which destroy its vigor, and, although it is very hardy and grows rapidly while young, is not long-lived or satisfactory either as a timber or an ornamental tree.

Other geographical forms of the Corsican Pine are *Pinus Laricio Calabrica* (Beissner, *l. c.* 241 [1891]) of the mountains of southern Italy; *Pinus Laricio Pallasiana* (Endlicher, *l. c.* 179 [1847]) of the Crimea; and *Pinus Laricio Cebennensis* (Grenier & Godron, *Fl. Franç.* iii. 153 [1855]) of the Cévennes.

[21] De Chambray, *l. c.* 342 (1845).

Pinus excelsa, Lambert, *Pinus*, ed. 2, i. t. (not Lamarck) (1828). — Wallich, *Pl. As. Rar.* iii. 1, t. 201. — Forbes, *l. c.* 75, t. 29. — Antoine, *l. c.* 42, 1, t. 20, f. 1. — Link, *l. c.* 515. — Madden, *Jour. Agric. and Hort. Soc. Ind.* iv. pt. iv. 226; vii. pt. ii. 80 (*Himalayan Coniferæ*). — Endlicher, *l. c.* 145. — Carrière, *l. c.* 300. — Gordon, *l. c.* 222. — Hoopes, *l. c.* 128, f. 17. — Parlatore, *De Candolle Prodr.* xvi. pt. ii. 404. — K. Koch, *Dendr.* ii. pt. ii. 321. — Aitchison, *Jour. Linn. Soc.* xviii. 97 (*Fl. Kuram Valley*). — Boissier, *Fl. Orient.* v. 698. — Hooker f. *Fl. Brit. Ind.* v. 651. — Beissner, *l. c.* 283, f. 69.

Pinus Griffithii, McClellan, *Griffith Notul.* iv. 17 (1854); *Icon. Pl. Asiat.* t. 365.

Pinus Nepalensis, the Himalayan representative of that group of five-leaved Pines of which the North American *Pinus Strobus* and *Pinus Lambertiana* are the best known members, inhabits mountain slopes from Afghanistan to Bhotan between elevations of five thousand and twelve thousand five hundred feet above the sea, where it is scattered through the forests of deciduous-leaved trees, or is mixed with other conifers, or sometimes covers considerable areas nearly to the exclusion of all other trees. It attains, under favorable conditions, a height of one hundred and fifty feet, with a tall straight trunk often three or four feet in diameter and covered with dark-colored fissured bark, slender drooping blue-green leaves from five to eight inches in length, and elongated cones, and produces light brown straight-grained resinous wood which is easy to work. This is much used in northern India in building and for shingles, water-channels, troughs, and agricultural implements; it is largely made into charcoal for iron smelting, and is employed for torches, small pieces used for lighting houses being sold in considerable quantities. The bark is employed for the roofs of huts; the leaves and young branches supply domestic animals with litter, and the leaves are mixed with mortar (Brandis, *Forest Fl. Brit. Ind.* 510. — Gamble, *Man. Indian Timbers*, 398. — Balfour, *Encyclopædia of India*, ed. 3, iii. 220).

Pinus Nepalensis, or the Bhotan Pine as it is often called, is a favorite ornament of the parks and gardens of temperate Europe, and of the eastern United States, where it is hardy as far north as Massachusetts. Growing in cultivation with great rapidity while young, it often suffers in the United States from the splitting of the bark, and is usually short-lived in the north; in the middle states it promises to be longer lived, and handsome specimens already from forty to fifty feet in height exist in the neighborhood of New York and Philadelphia.

[22] Parlatore, *l. c.* 388 (1868). — Franchet & Savatier, *Enum.*

Pl. Jap. i. 464. — Masters, *Jour. Linn. Soc.* xviii. 504 (*Conifers of Japan*). — Mayr, *Monog. Abiet. Jap.* 69, t. 5, f. 16, t. 7, f. 1. — Beissner, *Handb. Nadelh.* 248.

Pinus sylvestris, Thunberg, *Fl. Jap.* 274 (not Linnæus) (1784).

Pinus Pinaster, Loudon, *Arb. Brit.* iv. 2218 (in part) (not Aiton) (1838). — Gordon, *Pinetum*, 176 (in part).

Pinus Massoniana, Siebold & Zuccarini, *Fl. Jap.* ii. 24, t. 113, 114 (not Lambert) (1842 ?). — Endlicher, *Syn. Conif.* 174. — Carrière, *Traité Conif.* 378. — A. Murray, *Pines and Firs of Japan*, 23, f. 39–54. — Miquel, *Ann. Mus. Bot. Lugd. Bat.* iii. 166 (*Prol. Fl. Jap.*). — K. Koch, *Dendr.* ii. pt. ii. 282. — Gordon, *l. c.* ed. 2, 241.

Pinus Thunbergii, the Kura-matsu or Black Pine of Japan, inhabits northern China and Corea. In Japan it is extremely rare except in cultivation, if it ever grows naturally, but has been extensively planted and appears as a tree frequently eighty feet in height, with a trunk three feet in diameter covered with deeply furrowed dark bark, a broad head of stout contorted often pendulous branches, thick dark green leaves in clusters of two, white branch buds, and small clustered cones.

It is with this tree that the plantations on the sandy coast-plains of Japan are chiefly made ; it shades many of the principal highways of the country, and is used to cover arbors with its artificially elongated branches, or to hang over the sides of moated walls ; it is to be seen in every garden, where it is frequently dwarfed or trained in fantastic shapes, and by the Japanese is the most revered of all Pine-trees. The wood is moderately strong but coarse-grained and resinous, and in Japan is used in large quantities in the construction of buildings and for fuel, being rendered cheap by the rapid growth of the tree on sterile sandy soil unsuitable for the production of other crops (Dupont, *Essences Forestières du Japon*, 10. — Rein, *Industries of Japan*, 236, 273. — Sargent, *Forest Fl. Jap.* 79).

Pinus Thunbergii has flourished for many years in the gardens of Europe, and in those of the eastern United States, where it is perfectly hardy as far north, at least, as eastern Massachusetts (Sargent, *Garden and Forest*, vi. 458).

[23] Siebold & Zuccarini, *l. c.* 22, t. 112 (1842 ?). — Endlicher, *l. c.* 172. — Carrière, *l. c.* 376. — Gordon, *l. c.* Suppl. 58. — A. Murray, *l. c.* 32, f. 55–68. — Miquel, *l. c.* 165. — Parlatore, *De Candolle Prodr.* xvi. pt. ii. 388. — K. Koch, *l. c.* 285. — Franchet & Savatier, *Enum. Pl. Jap.* i. 464. — Masters, *l. c.* 503. — Mayr, *l. c.* 72, t. 5, f. 17, t. 6, f., t. 7, f. 5. — Beissner, *l. c.* 247.

? Pinus Japonica, Forbes, *Pinetum Woburn.* 33 (1839). — Antoine, *Conif.* 23.

Pinus scopifera, Miquel, *Zollinger Syst. Verz. Ind. Archip.* 82 (1854).

Pinus Pinea, Gordon, *l. c.* 179 (in part) (not Linnæus) (1858).

Pinus densiflora, the Aka-matsu or Red Pine of Japan, is common in the mountain forests of central Hondo at elevations of from three to four thousand feet above the sea-level, where it is very generally distributed among deciduous-leaved trees ; it also grows in Corea and northern China. It is a tree seventy or eighty feet in height, with a slender trunk covered toward the top and on the short slender contorted branches with thin light red bark separating in loose scales, with thin light green leaves in clusters of two, and small crowded cones. The Red Pine is generally planted with the Black Pine in the artificial forests of Japan, but is less frequently used in Japanese gardens. In commerce the wood is not distinguished from that of *Pinus Thunbergii*, and is used for the same purposes (Dupont, *l. c.* 10. — Rein, *l. c.* — Sargent, *Forest Fl. Jap.* 79). *Pinus densiflora*, which often appears in gardens under the name of *Pinus Massoniana*, is perfectly hardy in New England, where it produces cones in great profusion, and already begins to show the picturesque habit which distinguishes it in its native land (Sargent, *Garden and Forest*, ii. 538).

[24] Aiton, *Hort. Kew.* iii. 367 (1789). — Lambert, *Pinus*, i. 21, t. 9. — Willdenow, *Spec.* iv. pt. i. 496. — Link, *Abhand. Akad. Berl.* 1827, 175 ; *Linnæa*, xv. 498. — Forbes, *l. c.* 29. — Antoine, *l. c.* 18, t. 6, f. 1. — Visiani, *Fl. Dalm.* i. 199. — Schouw, *Ann. Sci. Nat.* sér. 3, iii. 235 (*Conifères d'Italie*). — Endlicher, *l. c.* 168. — Reichenbach, *Icon. Fl. German.* vi. 2, t. 575. — Carrière, *l. c.* 365. — Gordon, *Pinetum*, 176. — Willkomm & Lange, *Prodr. Fl. Hispan.* i. 19. — Parlatore, *Fl. Ital.* iv. 37 ; *De Candolle Prodr.* xvi. pt. ii. 382. — K. Koch, *l. c.* 290. — Laguna, *Coníferas y Amentáceas Españolas*, 29 ; *Fl. Forestal Española*, 89, t. 10. — Beissner, *l. c.* 221. — Hempel & Wilhelm, *Bäume und Sträucher*, i. 167, f. 92, 95.

Pinus sylvestris, β, Linnæus, *Spec.* 1000 (1753).

Pinus Laricio, Santi, *Viagg.* 59, t. 1 (not Poiret) (1795). — Savi, *Fl. Pis.* 253.

Pinus glomerata, Salisbury, *Prodr.* 398 (1796).

Pinus maritima, Poiret, *Lamarck Dict.* v. 337 (not Miller) (1804). — Brotero, *Fl. Lusitan.* ii. 284 ; *Hist. Nat. Pinheiros, Larices e Abetos*, 8. — De Candolle, *Lamarck Fl. Franç.* ed. 3, iii. 273. — *Nouveau Duhamel*, v. 240, t. 72, 72 bis.

Pinus Syrtica, Thore, *Promenade en Gascogne*, 161 (1810).

Pinus Pinaster, which is usually called the Maritime Pine, is a tree sixty or seventy feet in height, with a stout and often more or less inclined or crooked trunk covered with very thick deeply fissured dark bark, a dense round-topped head, stout rigid dark green leaves in clusters of two and from five to eight inches in length, and large ovoid cylindrical lustrous dark brown cones borne in whorls in close many-coned clusters. It inhabits sandy plains generally near the coast in western and southern France, Spain, and Portugal, Corsica, Italy, Dalmatia, Greece, and Algeria, and has been largely planted to protect the shifting sands of the coast dunes and to cover the Landes of southwestern France. These plantations, commenced by Brémontier in 1789, now extend over at least three hundred square miles, and stretch along the shore of the Bay of Biscay from the Gironde to the Adour ; they have proved entirely successful and one of the greatest triumphs of modern agriculture, *Pinus Pinaster* being especially fitted to hold loose sands by its power to grow freely from seeds planted in exposed situations, its rapid growth in sterile soil, and the strong grasp of its powerful deep descending and spreading roots.

The wood of the Maritime Pine is hard, strong, coarse-grained, very resinous, and reddish brown, and is used in the construction of buildings, for railway-ties, telegraph-poles, and piles, and for fuel. This tree, however, is most valuable for its resinous products which are chiefly obtained in the planted forests of southwestern France, which are systematically worked for this crop and afford the principal employment to the inhabitants of the region.

In the French pineries trees with a trunk diameter of from twelve to eighteen inches are considered large enough to work profitably for resin. This is obtained by making near the ground a cut a few inches wide and about five inches high through the bark into the wood ; at the base of the cut a small earthen pot is hung to receive the resin, which flows into it over a flat piece of zinc ; during the season, which lasts from March until the middle of October, the cut is slightly enlarged upward once or twice a week to improve the flow of resin, until at the end of five or six years it is ten or twelve feet long, the pot being raised as the cut is carried upward and the workman being obliged to use a ladder made by cutting notches in a small pole in order to empty it. The

cut is then abandoned and a fresh one is made on the opposite side of the tree, and when this has reached a height of ten or twelve feet a third and then a fourth cut is made. In this way the tree continues productive for many years, the old cuts healing over by the formation of fresh bark so that eventually second cuts may be made in their places. By this system only one wound is worked at the same time, but when trees are to be cut down a number of wounds are made and worked simultaneously in order to obtain the largest yield of resin in a short time. Broad fire-paths are kept clean through these pineries to check the spread of fires, which always menace forests worked for the production of resin.

The resin collected from the trees in the small pots is poured into large pits lined with planks, and later is boiled in copper kettles to free it from impurities; it is then filtered into barrels through a layer of straw spread horizontally and four or five inches thick, and in this state is the brown resin of commerce. During the summer months the resin is sometimes purified by exposing it to the sun in large square wooden boxes. The heat liquefies the resin, which drips through a number of small holes made in the bottom of the boxes into vessels placed beneath them, leaving the impurities behind. Yellow resin is made by gradually adding cold water to the boiling product; this causes it to melt and overflow into a trough fixed on one side of the kettle, through which it passes into a second vessel, and is then ladled back into the first, the operation being repeated several times until the whole mass becomes clear and yellow, when it is filtered through straw into moulds made in the sand, in which it hardens and is then ready for market.

When the trees can be no longer profitably worked for resin they are felled, and the stems and roots are cut up into small pieces which are piled on gratings, covered with a thick coat of wet clay, and burnt. In this manner tar, which, however, is considered inferior to that produced from *Pinus sylvestris*, is obtained. Oil of turpentine is made by distilling the resin of the Maritime Pine; and lamp-black by burning the straw used in filtering the resin in specially made furnaces, which deposit the soot of the smoke on the walls of small chambers through which it is passed. From the buds and young shoots syrups are distilled which are used locally in the treatment of catarrhal and pulmonary complaints. (For descriptions of the pineries of *Pinus Pinaster* in southwestern France and their products, see Brémontier, *Mémoire sur les Dunes et particulièrement sur celles qui se trouvent entre Bayonne et la Pointe de Grave.* — Chaptal, *Instructions sur la manière d'extraire le Goudron et autres principes résineaux du Pin.* — Vétillart, *Observations Pratiques sur la Culture du Pin Maritime.* — A. Richard, *Hist. Mat. Méd.* iii. 168. — Loudon, *Arb. Brit.* iv. 2213. — Lorentz, *Annales Forestières*, i. 57, 119 [*Notice sur le Pin Maritime*]. — De Chambray, *Traité Arb. Rés. Conif.* 201. — Trochu, *Création de la Ferme et des Bois de Brulé sur un Terrain des Landes.* — Brongniart, *Annales Forestières*, xi. 169, 197, 225, 253, 281 [*Mém. sur les Plantations Forestières dans la Sologne*]. — Boitel, *Du Pin Maritime.* — Demaude, *Du Gemmage des Pins et de la Plantation des Bois en Sologne.* — Hippolite Dive, *Monographie Industrielle et Commerciale du Pin Maritime.* — Samanos, *Traité de la Culture du Pin Maritime.* — Dessort, *Du Pin Maritime et de ses Produits.* — Paul Dive, *Essai sur un Arbre du Genre Pinus qui croit spontanément dans les Landes de Gascogne.* — Reveil, *Annales Forestières*, xxiv. 143, 176 [*Du Pin Maritime*]. — Guibourt, *Hist. Drog.* ed. 7, ii. 259. — J. C. Brown, *Pine Plantations on the Sand-Wastes of France.* — Mathieu, *Fl. Forestière*, ed. 3, 532. — Spons, *Encyclopœdia of the Industrial Arts, Manufactures, and Raw Commercial Products*, ii. 1688. — Poore, *Essays on Rural Hygiene*, 298 [*The Story of Brémontier*].)

Pinus Pinaster was introduced into Great Britain in the middle of the sixteenth century, and is frequently cultivated in central and western Europe as an ornament of parks and gardens. It is not hardy in the northern United States, but may be expected to thrive on the coast of the south Atlantic states. In California it grows very rapidly on the sand dunes of the coast in the neighborhood of San Francisco, and promises to attain a large size there, as well as in the gardens in the central and southern parts of the state. It has become common in southern Africa, and appears to be better suited for cultivation and more generally naturalized in many warm countries than any other Pine-tree (F. Mueller, *Select Plants Readily Eligible for Industrial Culture or Naturalization in Victoria*, 174. — Nicholson, *Garden and Forest*, ii. 208).

[25] Miller, *Dict.* ed. 8, No. 8 (1768); *Dict. Icon.* 139, t. 208. — Desfontaines, *Fl. Atlant.* ii. 352. — Lambert, *Pinus*, i. 15, t. 11. — *Nouveau Duhamel*, v. 238, t. 70. — Link, *Abhand. Akad. Berl.* 1827, 177; *Linnæa*, xv. 496. — Forbes, *Pinetum Woburn.* 25, t. 8. — Antoine, *Conif.* 2, t. i. f. 3. — Visiani, *Fl. Dalm.* i. 200. — Schouw, *Ann. Sci. Nat.* sér. 3, iii. 237 (*Conifères d'Italie*). — Endlicher, *Syn. Conif.* 180. — Reichenbach, *Icon. Fl. German.* xi. 2, t. 576. — Carrière, *Traité Conif.* 393. — Gordon, *Pinetum*, 165. — Willkomm & Lange, *Prodr. Fl. Hispan.* i. 19. — Christ, *Flora*, xlvi. 369. — Parlatore, *Fl. Ital.* iv. 40; *De Candolle Prodr.* xvi. pt. ii. 383. — K. Koch, *Dendr.* ii. pt. ii. 294. — Laguna, *Coníferas y Amentáceas Españolas*, 29; *Fl. Forestal Española*, 83, t. 9. — Boissier, *Fl. Orient.* v. 695. — Beissner, *Handb. Nadelh.* 221. — Hempel & Wilhelm, *Bäume und Sträucher*, i. 162, f. 85–89, t. 7.

Pinus sylvestris, Gouan, *Fl. Monsp.* 418 (not Linnæus) (1765).

Pinus maritima, Miller, *l. c.* No. 7 (1768). — Lambert, *l. c.* ii. 30, t. 10. — Willdenow, *Spec.* iv. pt. i. 497. — Brotero, *Fl. Lusitan.* ii. 284. — Sibthorp & Smith, *Prodr. Fl. Græc.* ii. 47; *Fl. Græc.* x. 39, t. 949. — Link, *Abhand. Akad. Berl.* 1827, 177; *Linnæa*, xv. 495. — Endlicher, *l. c.* 181. — Reichenbach, *l. c.* 3, t. 527. — Ledebour, *Fl. Ross.* iii. 676.

Pinus Alepensis, Poiret, *Lamarck Dict.* v. 338 (1804). — De Candolle, *Lamarck Fl. Franç.* ed. 3, iii. 274. — Brotero, *Hist. Nat. Pinheiros, Larices e Abetos*, 12.

Pinus Pityusa, Steven, *Bull. Soc. Nat. Mosc.* i. 49 (1838). — Strangways, *Gard. Mag.* n. ser. vi. 638. — Carrière, *l. c.* 395.

Pinus Halepensis is a tree usually from twenty to thirty feet tall, with a trunk generally not more than eighteen inches in diameter, and covered while young with smooth lustrous silver gray bark which in old age becomes thick, deeply furrowed, and dark red-brown, and a round-topped irregular crown of thin light-colored foliage. The leaves are borne in two-leaved clusters, and are slender, from two to four inches in length, gray or blue-green, and about as long as the distinctly stalked recurved reddish brown cones, which are lateral and solitary or borne in few-coned clusters.

Pinus Halepensis inhabits the Mediterranean basin, where it is distributed from Portugal and northern Africa to Syria, Arabia, and Asia Minor. On the Taurus it ascends to elevations of 3,500 feet above the sea-level, and here, in Greece on the rocky hills of Attica, on the shores of the Gulf of Lepanto and on the islands of the Archipelago, and on the mountains of southern Spain, it forms great open forests. It is the most widely and generally distributed Pine-tree of northern Africa, sometimes attaining in Tunis a height of nearly a hundred feet. (See Legrand, *Nouv. Ann. de la Marine et des Colonies*, 1854 [*Mém. sur les Richesses Forestières de l'Algérie*, 60]. — Livet, *La Tunisie ses Eaux et ses Forêts*, 25. — Lamey, *Forêts de la Tunisie*, 152.) Hardy and robust, it flourishes in all soils and exposures, and on dry exposed sun-baked slopes, where other trees cannot maintain a foothold. The

Aleppo Pine requires, however, light and heat, and does not endure the winters of cold countries. Its great value consists in the protection it is able to afford the soil of steep dry hillsides. The wood, although coarse-grained and resinous, is somewhat used in construction, especially in northern Africa, and largely for fuel. In southern France and in the eastern Mediterranean countries the forests of Aleppo Pine are worked for the production of resin, which, however, it yields in smaller quantities than *Pinus Pinaster*. (See Loudon, *Arb. Brit.* iv. 2233. — Mathieu, *Fl. Forestière*, ed. 3, 529.)

[26] *Pinus Roxburghii.*

Pinus longifolia, Lambert, *Pinus*, i. 29, t. 21 (not Salisbury) (1803). — *Nouveau Duhamel*, v. 247. — Willdenow, *Spec.* iv. pt. ii. 500. — Roxburgh, *Fl. Ind.* ed. 2, iii. 651. — Royle, *Ill.* 353, t. 85, f. 1. — Forbes, *Pinetum Woburn.* 55, t. 20. — Antoine, *Conif.* 29, t. 9. — Link, *Linnæa*, xv. 507. — Endlicher, *Syn. Conif.* 158. — McClellan, *Griffith Notul.* iv. 18; *Icon. Pl. Asiat.* t. 369, 370. — Madden, *Jour. Agric. and Hort. Soc. Ind.* iv. pt. iv. 223; vii. pt. ii. 75 (*Himalayan Coniferæ*). — Carrière, *Traité Conif.* 332. — Gordon, *Pinetum*, 200. — Parlatore, *De Candolle Prodr.* xvi. pt. ii. 390. — Hooker f. *Fl. Brit. Ind.* v. 652. — Beissner, *Handb. Nadelh.* 251.

Pinus Roxburghii often forms open forests on the outer ranges of the Himalayas, where it is distributed from Afghanistan to Bhotan, usually at elevations of from fifteen hundred to six thousand feet above the level of the sea, although in Kamaon occasionally ascending fifteen hundred feet higher, and flourishing equally in the humid semitropical valleys of Sikkim and on the arid sandstone hills of the upper Punjab. It is a tree sometimes a hundred feet in height, with a tall and usually naked trunk occasionally four feet in diameter, although it is generally smaller and often gnarled and stunted; it has thick and deeply furrowed bark, a round-topped open head of stout branches often ascending at the extremities, dark or light green leaves in clusters of three and from nine to twelve inches in length, and long solitary or whorled cones. It produces moderately hard and strong easily worked yellow or red-brown resinous wood, which, although not durable, is largely used in many of the northern districts of India in construction, for shingles and tea-chests, and in the manufacture of charcoal. This tree furnishes the largest part of the resin produced in India; it is obtained by making triangular-shaped incisions or cups in the trunk, or by stripping off the bark, the usual product from an average sized tree being from ten to twenty pounds in the first year and about one third as much in the second year, after which the tree generally dies. Tar is obtained by the slow combustion of chips of the resinous wood in earthen pots closed and covered with wet soil; dried cow-dung is used as fuel, and the tar, running through holes in the bottom of the pot, flows into a second jar buried in the ground below it. Spirits of turpentine is distilled in some of the northwest provinces from the crude turpentine yielded by this tree (*Pharmacographia Indica*, vi. 378). Pieces of the wood of stumps of trees which have been worked for turpentine are used for torches, and as candles in houses and mines. The bark contains considerable quantities of tannin identical with that of oak bark, and is used in India in tanning leather, and as fuel in smelting iron (Bastin & Trimble, *Am. Jour. Pharm.* lxviii. 139). Charcoal made from the leaves mixed with rice water serves as a substitute for ink; and the seeds are edible, sometimes furnishing in times of famine an important supply of food (Brandis, *Forest Fl. Brit. Ind.* 506. — Gamble, *Man. Indian Timbers*, 396. — Balfour, *Encyclopædia of India*, ed. 3, iii. 221).

Pinus Roxburghii is cultivated on the plains of northern India, but it has not proved hardy in Europe except in exceptionally favorable positions, or in the eastern United States; and it is rarely seen in the gardens of temperate countries.

[27] Tar by distillation yields pyroligneous acid and oil of tar, the residue being pitch, which is largely used commercially in caulking vessels and medicinally as a gentle stimulant and tonic. Tar is employed in cases of chronic catarrh; its vapor is inhaled in the treatment of bronchitis; and ointment of tar is sometimes applied to relieve cutaneous diseases (*U. S. Dispens.* ed. 16, 1174).

[28] Oil of turpentine is used as a solvent for several resins and for sulphur, phosphorus, caoutchouc, wax, and fats, and is largely consumed in the manufacture of varnish and paint.

[29] Woodville, *Med. Bot.* iii. 572. — Flückiger & Hanbury, *Pharmacographia*, 545. — Johnson, *Man. Med. Bot. N. Am.* 256. — Millspaugh, *Am. Med. Plants in Homœopathic Remedies*, ii. 163–2. — *U. S. Dispens.* ed. 16, 1485.

[30] Spons, *Encyclopædia of the Industrial Arts, Manufactures, and Raw Commercial Products*, ii. 1408.

[31] Spons, *l. c.* 1680.

[32] Linnæus, *Spec.* 1000 (1753). — Desfontaines, *Fl. Atlant.* ii. 352. — Lambert, *Pinus*, i. 11, t. 6–8. — Brotero, *Fl. Lusitan.* ii. 286; *Hist. Nat. Pinheiros, Larices e Abetos*, 11. — Willdenow, *Spec.* iv. pt. i. 497. — De Candolle, *Lamarck Fl. Franç.* ed. 3, iii. 273. — *Nouveau Duhamel*, v. 242, t. 72 bis, f. 3, t. 73. — Link, *Abhand. Akad. Berl.* 1827, 178; *Linnæa*, xv. 499. — Antoine, *l. c.* 20, t. 3, f. 2. — Visiani, *Fl. Dalm.* i. 199. — Schouw, *Ann. Sci. Nat.* sér. 3, iii. 236 (*Conifères d'Italie*). — Endlicher, *l. c.* 182. — Reichenbach, *Icon. Fl. German.* xi. 3, t. 528, 530. — Koch, *Syn. Fl. German.* ed. 3, ii. 578. — Carrière, *l. c.* 402. — Gordon, *l. c.* 179. — Willkomm & Lange, *Prodr. Fl. Hispan.* i. 20. — Parlatore, *Fl. Ital.* iv. 34; *De Candolle Prodr.* xvi. pt. ii. 381. — K. Koch, *Dendr.* ii. pt. ii. 270. — Laguna, *Coniferas y Amentáceas Españolas*, 29; *Fl. Forestal Española*, 49, t. 4, 5. — Boissier, *Fl. Orient.* v. 694. — Beissner, *l. c.* 220. — Hempel & Wilhelm, *Bäume und Sträucher*, 170, f. 94, 95.

Pinus fastuosa, Salisbury, *Prodr.* 398 (1796).

Pinus Maderiensis, Tenore, *Ind. Sem. Hort. Neap.* 1854; *Ann. Sci. Nat.* sér. 4, ii. 379.

Pinus Pinea now inhabits the Mediterranean basin from Portugal to Syria, growing usually in the neighborhood of the coast and often forming pure forests of considerable extent, although it is not improbable that the region it occupied naturally has been extended westward through ancient cultivation, as this Pine, which was valued by the Greeks and Romans for its picturesque habit as well as for its edible seeds, in southern France and Spain rarely grows far from human habitations. It is a tree with a stout erect or often inclining trunk free of branches for fifty or sixty feet, covered with thin smooth reddish bark, and surmounted with a flat parasol-like head of spreading branches; it has deep dark green leaves in clusters of two and seven or eight inches in length, stout ovate obtuse cones, almost as long as the leaves, which do not mature until the third season, and thick-shelled nearly cylindrical seeds three quarters of an inch in length. The wood is almost white, slightly resinous and easily worked, and in southern Europe is sometimes used for the interior finish of buildings, in cabinet-making, and for water pipes and the outside sheathing of boats. The Stone Pine, as this tree is commonly called in English, is most valued, however, for its abundant crops of seeds. These furnish a large amount of food to the inhabitants of southern Europe, who eat them roasted, or grind them into flour; they are exported in small quantities to northern Europe and the United States, and the large Pine seeds sold in the markets of eastern American cities are the product of *Pinus Pinea*.

The Stone Pine is cultivated often on a large scale in southern Europe for its seeds; as an ornamental tree it has been freely used to decorate the gardens of Italy and the other countries of southern Europe, which owe much to its peculiar and picturesque habit. (See Gilpin, *Forest Scenery*, i. 83. — Loudon, *Arb. Brit.* iv. 2224, t.) It was introduced into British plantations before the middle of the sixteenth century, but, although it survives the winters in favored localities in southern England and Ireland, it does not flourish there; in the United States it is not hardy in the middle and northern Atlantic states, but in California the Stone Pine, although still young, promises to grow rapidly to its largest size.

[33] Linnæus, *Spec.* 1000 (1753). — Lambert, *Pinus*, i. 34, t. 23, 24. — Willdenow, *Spec.* iv. pt. i. 500. — De Candolle, *Lamarck Fl. Franç.* ed. 3, iii. 275. — *Nouveau Duhamel*, v. 248, t. 77, f. 1. — Brotero, *Hist. Nat. Pinheiros, Larices e Abetos*, 20. — Link, *Abhand. Akad. Berl.* 1827, 179; *Linnæa*, xv. 513. — Ledebour, *Fl. Alt.* iv. 200; *Fl. Ross.* iii. 673. — Forbes, *Pinetum Woburn.* 69, 73, t. 27. — Antoine, *Conif.* 45, t. 20, f. 2. — Schouw, *Ann. Sci. Nat.* sér. 3, iii. 238 (*Conifères d'Italie*). — Endlicher, *Syn. Conif.* 141. — Reichenbach, *Icon. Fl. German.* xi. 3, t. 530. — Hartig, *Forst. Culturpfl. Deutschl.* 77, t. 7. — Carrière, *Traité Conif.* 295. — Koch, *Syn. Fl. German.* ed. 3, ii. 578. — Gordon, *Pinetum*, 219. — Parlatore, *Fl. Ital.* iv. 55; *De Candolle Prodr.* xvi. pt. ii. 402. — K. Koch, *Dendr.* ii. pt. ii. 316. — Masters, *Jour. Linn. Soc.* xviii. 505 (*Conifers of Japan*). — Beissner, *Handb. Nadelh.* 276, f. 65–67. — Hempel & Wilhelm, *Bäume und Sträucher*, i. 173, f. 99–106, t. 8.

Pinus montana, Lamarck, *Fl. Franç.* iii. 651 (not Miller) (1778).

Pinus Cedrus, Uspenski, *Bull. Soc. Nat. Mosc.* 1834, 389 (not Linnæus).

Pinus Cembra, γ *Helvetica*, Forbes, *l. c.* 71 (1839).

Pinus Cembra inhabits the mountains of central Europe, where, mingled on the lower slopes with the upper Spruces and Firs, it ascends above the Mountain Pine and the Larch, and with Alders, Rhododendrons, and alpine Willows forms scattered groves along the timber-line at elevations as high as seven thousand five hundred feet above the sea-level; it is common in northern Russia and in Siberia, where it sometimes forms pure forests of great extent. It is an exceedingly slow-growing tree, with an erect trunk covered with smooth pale bark and clothed while young with short slender horizontal whorled branches forming a narrow symmetrical pyramid which becomes open and picturesque in old age by the turning up of the branches; it occasionally attains a height of one hundred and twenty feet, although on the mountains of Europe it is rarely more than half this size. The leaves are borne in from three to five-leaved clusters and are short, stout, rigid, blue-green, clustered at the ends of the thick branchlets, and nearly as long as the ovate erect cones, which are about three inches long and two and a half inches wide, with broad thin scales and somewhat triangular seeds half an inch in length. The wood of *Pinus Cembra* is soft, close-grained, nearly white and slightly tinged with red, easily worked, and very durable; it is valued in cabinet-making and turnery, and is largely employed in Europe for wood-carvings. The seeds are used as food, and oil employed as food and for illuminating purposes is pressed from them in Europe. (Loudon, *Arb. Brit.* iv. 2274. — Mathieu, *Fl. Forestière*, ed. 3, 543.) In Siberia the seeds often form an important article of diet and are employed medicinally. (See Gmelin, *Fl. Sibir.* i. 181.) Carpathian balsam, a colorless oleo-resin with a pleasant odor and an acrid bitter flavor, is derived from *Pinus Cembra*.

Pinus Cembra, in spite of its slow growth, has long been valued as an ornament of parks and gardens, and is frequently planted in the eastern United States, where it is hardy in New England.

The dwarf Pine, which covers the high summits of the mountains of northern Japan with broad almost impenetrable thickets four or five feet high, grows also in Saghalin, Kamtschatka, and the Kurile Islands, and is erroneously said to cross Bering Strait to the Aleutian Islands, has often been considered a variety of *Pinus Cembra*, but from its habit and geographical range is now usually considered a species. It is: —

Pinus pumila, Regel, *Cat. Sem. Hort. Petrop.* 1858, 23; *Bull. Soc. Nat. Mosc.* xxxii. pt. i. 211; *Russ. Dendr.* ed. 2, pt. i. 48. — Trautvetter, *Act. Hort. Petrop.* ix. 210 (*Incrementa Fl. Ross.*). — Mayr, *Monog. Abiet. Jap.* 80, t. 6, f. 21. — Herder, *Act. Hort. Petrop.* xi. 91 (*Pl. Radd.*).

Pinus Cembra, b *pumila*, Pallas, *Fl. Ross.* i. 4, t. 2, f. E–H (1784). — Endlicher, *l. c.* 142. — Maximowicz, *Mém. Sav. Étr. Acad. St. Pétersbourg*, ix. 262 (*Prim. Fl. Amur.*). — Parlatore, *De Candolle Prodr. l. c.* 402. — Masters, *l. c.*

Pinus Cembra pygmæa, Loudon, *l. c.* 2276 (1838).

Pinus Mandshurica, Ruprecht, *Bull. Phys. Math. Acad. Sci. St. Pétersbourg*, xv. 382 (1857).

[34] D. Don, *Lambert Pinus*, ed. 2, ii. t. (1828). — Forbes, *l. c.* 53, t. 19. — Royle, *Ill.* 353, t. 85, f. 2. — Antoine, *l. c.* 29, t. 10. — Madden, *Jour. Agric. and Hort. Soc. India*, iv. pt. iv. 228; vii. pt. ii. 83 (*Himalayan Coniferæ*). — Endlicher, *l. c.* 159. — Carrière, *l. c.* 333. — Gordon, *l. c.* 195. — Parlatore, *l. c.* 391. — K. Koch, *l. c.* 315. — Aitchison, *Jour. Linn. Soc.* xviii. 98 (*Fl. Kuram Valley*). — Boissier, *Fl. Orient.* v. 696. — Hooker f. *Fl. Brit. Ind.* v. 652. — Beissner, *l. c.* 250.

Pinus Gerardiana is a tree, occasionally sixty feet in height, with a trunk four feet in diameter, although usually much smaller and generally only thirty or forty feet tall, with thin smooth gray-green or silvery bark exfoliating in long thin scales and exposing as they separate the smooth darker colored inner bark, a broad round-topped head of stout spreading or pendent branches ascending toward their extremities, smooth dark brown branchlets, dark green leaves in clusters of three, stout cones from six to nine inches in length, and cylindrical seeds an inch long. It inhabits the arid inner valleys of northwestern India, growing usually at altitudes varying from five thousand eight hundred feet to twelve thousand feet above the sea, often on dry steep rocky slopes; and, although gregarious, it does not generally form pure forests, being frequently associated with the Deodar. The seeds are so valuable for food that the trees are rarely cut, and the hard resinous dark yellow-brown wood is little used. Baskets and water-buckets are, however, made from the bark. The cones are gathered before they open and are heated to expand the scales and secure the seeds. These are stored for winter use, and are often ground and mixed with flour. In Kunawar they are a staple article of food, and they form a considerable article of Indian commerce. The seeds and the oil extracted from them are used medicinally in India in native practice (Balfour, *Encyclopædia of India*, ed. 3, iii. 221).

In the gardens of western and central Europe *Pinus Gerardiana* survives, but grows very slowly; and it has not yet shown its ability to endure the climate of the United States.

[35] Spons, *Encyclopædia of the Industrial Arts, Manufactures, and Raw Commercial Products*, ii. 1427. — Jackson, *Commercial Botany of the 19th Century*, 136.

[36] Jackson, *Gard. Chron.* ser. 3, iii. 171. — Mohr, *Bull.* No. 13 *Forestry Div. U. S. Dept. Agric.* 48 (*Timber Pines of the Southern U. S.*).

[37] Soubeiran & Thiersant, *Mat. Méd. Chin.* 134.

[88] Höhnel, *Die Gerberinden*, 15, 31, 45. — Neubrand, *Die Gerberinden*, 219. — Watt, *The Art of Leather Manufacture*, 86.

[39] The planting of Pines and other Conifers for the production of timber has been practiced in Japan for at least twelve hundred years, and the wood used in the empire is nearly all obtained from planted forests which cover sandy coast plains and other lands unfit for the production of agricultural crops.

[40] The different North American Pines are infested by many species of insects; of these some are very destructive or are liable to become so. It is probable that only a small part of the insects affecting the trees of this genus in America are known. Packard (*Fifth Rep. U. S. Entomolog. Comm.* 1890, 674) enumerates nearly one hundred and fifty species found on Pine-trees in the United States, and since the publication of his report the number has been much increased. Borers in the trunk, branches, and bark make about half the number of species which injure Pine-trees; they are chiefly coleopterous, those attacking the trunk belonging largely to the family Cerambycidæ and Buprestidæ, while numerous Scolytidæ attack the sapwood and bark. Larvæ of *Monohammus confusor*, Kirby, *Monohammus titillator*, Fabricius, *Monohammus scutellatus*, Say, and *Monohammus marmoratus*, Randall, are common in the trunks of Pines over a large extent of country, the first-named species being especially abundant. They sometimes do great damage, but usually prefer to attack dead trees or those which are already injured or diseased rather than perfectly healthy trunks. *Asemum mœstum*, Haldeman, *Criocephalus agrestis*, Kirby, and *Rhagium lineatum*, Olivier, are sometimes destructive, however, to living trees. Larvæ of *Callidium antennatum*, Newman, and numerous other Cerambycidæ bore into the wood when dry. Among Buprestidæ the larvæ of *Chalcophora Virginiensis*, Drury, often girdle the trunks and cause their destruction, and other species of Chalcophora infest them. Various species of Dicerca, Chrysobothris, Melanophila, are often abundant and destructive to Pine-trees. The White Pine weevil, *Pissodes Strobi*, Peck, is one of the worst pests of young trees. The larvæ live in the leading shoots or near the tops of the central stems and cause them to wither and die, or are found injuring the sapwood of older trees. *Hylobius Pales*, Herbst, is another weevil common in Pines over a large part of North America, and *Pachylobius picivorus*, Germar, is injurious in the southern states.

Among Scolytidæ, *Gnathotrichus materiarius*, Fitch, *Gnathotrichus asperulus*, Leconte, *Xyloterus bivittatus*, Mannheim, and various species of Carphoborus bore under the bark or in the sapwood. *Dendroctonus terebrans*, Olivier, and other species of this genus, several species of Xyleborus, *Tomicus Pini*, Say, *Tomicus cacographus*, Leconte, *Tomicus calligraphus*, Germar, *Hylurgops pinifex*, Fitch, species of Pityophthorus, Polygraphus, Crypturgus, and other beetles bore in or under the bark.

Among lepidopterous borers are several which injure the branches or the bark and sapwood of Pine-trees. *Bembicia Sequoiæ*, H. Edwards, which bores into Sequoia, is said to seriously affect also *Pinus ponderosa* and *Pinus Lambertiana* in California. *Ægeria Pinorum*, Behrens, has been found in *Pinus radiata* in California; and *Harmonia Pini*, Kellicott, attacks the bark and sapwood of Pines in the middle states. The larva of a Pyralid, *Nephopteryx Zimmermanni*, Grote, bores under the bark and in the young wood of Pine-trees usually below the insertion of young branches, and causes resinous exudations.

The branchlets, especially of *Pinus rigida* and its allies, are frequently affected by the larvæ of small Tortricid moths chiefly of the genus Retinia; their attacks are often accompanied by copious exudations of resinous juice and result in the death of the twigs, or by weakening them cause the leaves to turn yellow or brown.

The foliage of Pine-trees is injured in the United States by many species of insects, although few of them are noticeably destructive. Saw-flies of various species, chiefly belonging to the genera Lophyrus and Lyda, are sometimes abundant and are likely to cause considerable damage.

Among Lepidoptera, the larvæ of *Pieris Menapia*, Felder, is occasionally extremely abundant on *Pinus ponderosa*, *Pinus contorta*, and other species of the Pacific forests.

Semiothisa bisignata, Walker, and other Geometridæ, besides the insects belonging to other groups, are found on various species and occasionally cause considerable damage.

Tortrix politana, Haworth, forms little tubes composed of the living foliage of *Pinus Strobus*, and devours the outer ends of the leaves which form the tube within which it lives. *Gelechia pinifoliella*, Chambers, in its larval state mines the leaves of *Pinus rigida* and other species; and the leaves of this tree and its allies are also infested by a gall gnat, *Diplosis Pini-rigidæ*, Packard.

The leaves of young twigs are affected by many species of Hemiptera, among them spittle-insects, leaf-hoppers, aphids, and scale-insects.

Lachnus Strobi, Fitch, is common on the White Pine and often destroys young trees; and *Lachnus australis*, Ashmead, is found on twigs of *Pinus palustris* and allied species in the southern Atlantic states. A so-called "mealy-bug," *Schizoneura pinicola*, Thomas, also attacks *Pinus Strobus*.

Mytilaspis pinifoliæ, Fitch, is an elongated white scale common on the leaves of several species of Pines, and *Chermes pinifoliæ*, Fitch, and *Chionaspis pinifoliæ*, Fitch, sometimes injure these trees.

Several insects still little known often infest the cones of North American Pines.

[41] The diseases of the different species of Pinus caused by fungi are very numerous, and in Europe have been carefully studied with regard to their pathological action. In the United States some of the same diseases prevail, and there are also a large number of native fungi which are parasitic on North American Pines, causing them considerable injury. The rotting of the wood of Pines is generally due to certain species of Polyporus and Trametes, which attack Spruces and Firs as well, and also sometimes deciduous-leaved trees. One of the most widely spread species is *Trametes Pini*, Fries, a long-lived fungus of dark yellow-brown color which appears in the form of small brackets on the branches and trunks of *Pinus sylvestris* in Europe and the United States, on *Pinus contorta*, var. *Murrayana*, *Pinus palustris*, *Pinus Strobus*, and probably other species. It produces the disease known in Germany as Ringschäle, the mycelium extending up and down the trunk, especially in the annual rings, and forming brown streaks and zones. *Polyporus annosus*, Fries, which in Europe is regarded as the most destructive fungus to conifers, occurring there on *Pinus sylvestris* and *Pinus Strobus*, has been recorded on the latter species in this country, but not often, although it is probably more common than has usually been supposed. It generally attacks the roots and extends upward into the trunk. The mycelium causes the wood to become red and rotten, and eventually forms dark-colored longitudinal streaks and cavities. The fructifying part of this fungus is generally found on or near the roots, and is usually resupinate, with small white pores. *Polyporus Schweinitzii*, Fries, which is apparently more common in the United States than in Europe, is generally associated with *Pinus Strobus*. In Europe it produces a disease of *Pinus sylvestris*, although in this country, in spite of its frequency, it is not generally supposed to cause serious trouble.

This fungus seldom appears on the trunks, although it grows on their cut surfaces and is common on the ground under *Pinus Strobus*, being probably parasitic on its roots. It is a large species of a corky or spongy substance, at first covered with a yellow down but soon becoming dark brown. It is not improbable that it is a native of North America, and has been introduced into Europe. There are also a large number of Hymenomycetes which attack Pines in this country, but at present little is known definitely of their pathological effects.

A number of interesting rust-fungi produce discolorations and deformities of the leaves of Pines in the United States, and, in some cases, the peculiar distortion known as witches' brooms, although this deformity is more common on Spruce-trees than on Pines. The determination of the Rusts which infest conifers is difficult, owing to the fact that the greater part of them are æcidia, or cluster-cups, which resemble one another closely, but, according to recent writers, are genetically connected with teleutosporic fungi of quite different species. The rusts of Pines, with few exceptions, belong to the genus Peridermium which, like other æcidia, consist of orange or rust-colored spores arranged in chains contained within an envelope composed of colorless cells. The old species, *Peridermium Pini*, Léveillé, was supposed to have two forms, one producing cups on the leaves and the other cups or irregular disks on the trunks and branches. It has been shown that the forms on bark are connected with species of Cronartium, but the leaf Peridermium of European Pines is now separated into several species connected with different species of Coleosporium which grow on different Compositæ, as Senecio, Tussilago, Inula, and on Euphrasia and other plants. Few experiments have been made with artificial cultures of the North American Peridermia, and the determination of our species must still be regarded as provisional. *Peridermium Strobi*, common in Europe on *Pinus Strobus* introduced from North America, is not known to occur in this country, nor has *Cronartium ribicolum*, Dietrich, with which it is associated, been introduced here. Of North American corticolous forms may be mentioned *Peridermium Harknessii*, Moore, which forms nodes covered with confluent masses of æcidia on *Pinus ponderosa*, *Pinus radiata*, *Pinus Sabiniana*, and *Pinus contorta*, and *Peridermium Cerebrum*, Peck, on *Pinus rigida*. Of North American acicolous forms of Peridermium the most common is perhaps identical with *Peridermium oblongisporum*, Fuckel. This is not uncommon on *Pinus rigida* in early summer, but the teleutosporic form with which it is said to be united in Europe, *Coleosporium Senecionis*, Persoon, is certainly very rare here, although it has been noticed on *Senecio vulgaris* near Providence, Rhode Island. Besides the Rusts belonging to the genus Peridermium, *Coleosporium Pini*, Galloway (*Jour. Myc.* vii. 44. — *Bot. Gazette*, xxii. 433), attacks the leaves of *Pinus Virginiana* in the middle states, causing bands of yellow discolorations and a premature shedding of the leaves. Unlike other Rusts of Pine-trees, this species is a teleutosporic and not an æcidial form. The Rusts which are often found in abundance on cones of various Pine-trees, especially in the southern and western states, need further study.

A number of fungi of the order Hysteriaceæ are found on Pine-trees, most of them being species occurring on the bark without causing special disease so far as is now known. *Lophodermium Pinastri*, Chevallier, found on *Pinus contorta*, *Pinus palustris*, *Pinus rigida*, *Pinus Strobus*, and probably on other species, which appears to the naked eye as small narrow black spots on the leaves, kills them and causes them to fall prematurely. *Hypoderma brachysporum*, Rostrup, a species closely related to the last, produces a similar disease of *Pinus Strobus* in Europe, but is not known in this country. There are several other ascomycetous fungal parasites in the United States. *Cenangium ferruginosum*, Fries, occurs on the branches of *Pinus radiata*, *Pinus ponderosa*, *Pinus Sabiniana*, and *Pinus sylvestris* in this country. Under the name of *Cenangium Abietis*, Persoon, F. Schwartz (*Die Erkrankung der Kiefern durch Cenangium Abietis*) has given a full account of the epidemic caused by this fungus in Germany, the same disease having been previously observed by other botanists in that country and in Sweden. The species attacked were *Pinus sylvestris*, *Pinus Lambertiana*, *Pinus montana*, and *Pinus rigida*. In America no special epidemic has been observed, and most botanists have regarded the fungus as a saprophyte rather than a true parasite, although it appears to be capable at least of assuming at times a truly parasitic growth. *Phacidium crustaceum*, Berkeley & Curtis, which should probably be referred to the older *Phacidium Pini*, Albertini & Schweinitz, is very common on the branches of *Pinus Strobus*, which it covers with small depressed silvery gray pustules. *Chilonectria cucurbitula*, Saccardo, a polysporic form, is abundant on the smaller branches of *Pinus Strobus*, which it covers with small clusters of deep red perithecia. The exact relation of this common fungus to the true *Nectria cucurbitula*, Fries, has not been fully determined. The latter species is recognized in Europe as a cause of a marked disease, the mycelium, making its way into the branches of *Pinus sylvestris* through wounds, especially those caused by certain insects. *Caliciopsis Pinea*, Peck, which is found on the bark of *Pinus Strobus*, and *Polyporus volvatus*, Peck, which grows on the bark of *Pinus rigida*, are peculiar to these trees, which, however, do not appear to be injured by them. In southern Europe the tumors sometimes found on the branches of *Pinus Halepensis* are supposed to be due to the growth of bacteria which cause similar tumors on Olive-trees.

[42] *Inst.* 585, t. 355, 356.

CONSPECTUS OF THE NORTH AMERICAN SPECIES.

STROBUS. Cones subterminal; apophysis of the cone-scales thin, usually unarmed; leaves in clusters of five, their sheaths loose and deciduous; fibro-vascular bundle 1. Wood light-colored, soft. White Pines.

Eustrobi. Resin ducts peripheral.

Wings longer than the seeds; leaves sharply serrulate, denticulate toward the apex.

Hypoderm or strengthening cells of the leaves not surrounding the resin ducts.

Leaves slender, glaucous, from 3 to 4 inches in length; cones 5 or 6 inches long . . . 1. P. STROBUS.

Leaves thick, rigid, from 1½ to 4 inches in length; cones from 5 to 11 inches long . . 2. P. MONTICOLA.

Hypoderm or strengthening cells of the leaves numerous, surrounding the resin ducts.

Leaves stout, rigid, from 3½ to 4 inches in length; cones from 12 to 18 inches long . . . . . 3. P. LAMBERTIANA.

Wings much shorter than the seeds; leaves mostly entire, or denticulate toward the apex.

Leaves slender, from 3½ to 4 inches in length; cones from 5 to 9 inches long, their scales reflexed . . . . . 4. P. STROBIFORMIS.

Leaves thick, rigid, from 1½ to 3 inches in length; cones from 3 to 10 inches long, their scales thickened, light brown, pointed at the apex . . . . . 5. P. FLEXILIS.

Leaves thick, rigid, from 1½ to 2¼ inches in length; cones oval or subglobose, from 1½ to 3 inches long, their scales much thickened, dark purple, terminating in stout incurved nearly triangular tips . . . . . 6. P. ALBICAULIS.

PINASTER. Apophysis of the cone-scales thickened, usually armed; leaves in clusters of 1 to 5, their sheaths usually persistent. Wood resinous. Pitch Pines.

Resin ducts of the leaves peripheral.

Integrifoliæ. Cones subterminal; leaves entire, their sheaths deciduous; fibro-vascular bundle 1.

Cone-scales thick, unarmed; seeds large, their wings minute. Leaves in 1 to 5-leaved clusters. Nut Pines.

Leaves stout, glaucous, in 1 to 5, usually in 4-leaved, clusters, from 1¼ to 1½ inches in length; cones from 1½ to 2 inches broad . . . . . 7. P. QUADRIFOLIA.

Leaves slender, in 2 or 3-leaved clusters, from 1½ to 2 inches in length; cones from 1 to 2 inches broad . . . . . 8. P. CEMBROIDES.

Leaves stout, tipped with rigid spines, in 1 or 2-leaved clusters, from 1¼ to 2¼ inches in length; cones from 1½ to 2½ inches long . . . . . 9. P. MONOPHYLLA.

Leaves stout, rigid, sharp-pointed, in 2 or 3-leaved clusters, from ¾ of an inch to 1½ inches in length; cones from 1¼ to 1½ inches long . . . . . 10. P. EDULIS.

Cones dark purple, their scales somewhat thickened at the apex, armed with slender prickles; seeds shorter than their wings; leaves in crowded clusters of five, rigid, incurved.

Leaves from 1 to 1½ inches in length; cones subcylindrical, from 3½ to 5 inches long, their scales armed with minute incurved prickles . . . . . 11. P. BALFOURIANA.

Leaves from 1 to 1½ inches in length; cones from 3 to 3½ inches long, their scales armed with long slender awn-like prickles . . . . . 12. P. ARISTATA.

Sylvestres. Cones subterminal; leaves serrulate, their sheaths persistent; fibro-vascular bundles 2.

Leaves in 2-leaved clusters, slender, dark green, from 5 to 6 inches in length; cones ovate-conical, from 2 to 2¼ inches long, their scales slightly thickened, unarmed, seeds much shorter than their wings . . . . . 13. P. RESINOSA.

Resin ducts of the leaves parenchymatous.

Ponderosæ. Cones subterminal, their scales conspicuously umbonate; leaves in 2, 3, or 5-leaved clusters, their sheaths persistent, or deciduous in No. 17; fibro-vascular bundles 2.

Leaves in 5-leaved clusters.

Leaves stout, dark green, from 9 to 13 inches in length; cones broadly ovate, long-stalked, from 4 to 6 inches long, their scales much thickened, with broad reflexed umbos . . . . . 14. P. TORREYANA.

Leaves stout, dark green, from 5 to 7 inches in length; cones oval, from 2 to 2½ inches long, their scales armed with small recurved spines . . . . . 15. P. ARIZONICA.

Leaves in 2 or 3-leaved clusters.

Leaves in 3 or in 2 and 3-leaved clusters, from 3 to 15 inches in length; cones from 3 to 12 inches long, in falling separating from the lower scales persistent on the peduncle . . . . . 16. P. PONDEROSA.

Leaves in 3-leaved clusters, slender, pale green, from 2½ to 4 inches in length, their sheaths deciduous; cones broadly ovate, from 1½ to 2 inches long, maturing at the end of the third season, their scales slightly thickened, furnished with small recurved deciduous prickles . . . . . 17. P. CHIHUAHUANA.

Leaves in 2-leaved clusters, closely serrulate, from 1 to 4 inches long; cones oblong-oval, oblique, more or less serotinous, their scales often tuberculate, and armed with slender prickles . . . . . 18. P. CONTORTA.

Tædæ. Cones lateral, their scales much thickened, variously armed; leaves in 2 or in 3-leaved clusters, their sheaths persistent; fibro-vascular bundles 2; resin ducts parenchymatous.

Leaves in 3-leaved clusters.

Leaves slender, drooping, pale blue-green, from 8 to 12 inches in length; cones oval, acute, from 6 to 10 inches long, their scales produced into prominent umbos armed with stout straight or slightly incurved spines . . . . . 19. P. SABINIANA.

Leaves stout, erect, dark blue-green, from 6 to 12 inches in length; cones elongated-oval, acute, from 10 to 14 inches long, their scales much thickened into stout elongated umbos armed with thick spur-like incurved spines . . . . . 20. P. COULTERI.

Leaves slender, bright green, from 4 to 6 inches in length; cones oval, oblique, from 3 to 6 inches long, persistent, their scales mammillate on the outer side, armed with minute incurved prickles . . . . . 21. P. RADIATA.

Leaves pale yellow-green, from 5 to 7 inches in length; cones elongated-conical, oblique, clustered, from 3 to 5 inches long, serotinous, their scales unequally embossed, armed with stout prickles . . . . . 22. P. ATTENUATA.

Leaves slender, pale green, from 6 to 9 inches in length; cones ovate-oblong, from 3 to 5 inches long, their scales armed with stout recurved prickles . . . . . 23. P. TÆDA.

Leaves stout, rigid, dark yellow-green, from 3 to 5 inches in length; cones ovoid-conical or ovate, often clustered, from 1 to 3½ inches long, their scales armed with short stout recurved prickles . . . . . 24. P. RIGIDA.

Leaves slender, dark yellow-green, from 6 to 8 inches in length; cones usually subglobose, or elongated, from 2½ to 3 inches long, serotinous, their scales armed with slender incurved deciduous prickles . . . . . 25. P. SEROTINA.

Leaves in 2-leaved clusters, except in No. 31.

Leaves stout, gray-green, from 1½ to 3 inches in length; cones oblong-conical, often more or less curved, from 2 to 3 inches long, armed with slender straight or incurved prickles . . . . . 26. P. VIRGINIANA.

Leaves slender, flexible, dark green, from 2 to 3½ inches in length; cones ovoid-conical, serotinous, persistent for many years, their scales armed with short stout straight or recurved spines . . . . . 27. P. CLAUSA.

Leaves soft, slender, dark green, from 1½ to 3 inches in length; cones subglobose to oblong-ovate, from 1¼ to 2 inches long, their scales thin, tipped with straight or recurved short often deciduous prickles . . . . . 28. P. GLABRA.

Leaves stout, blue-green, from 1¼ to 2½ inches in length; cones oblong-conical, oblique, from 2 to 3½ inches long, their scales armed with stout hooked spines . . . . . 29. P. PUNGENS.

Leaves rigid, dark green, from 4 to 6 inches in length; cones ovate, oblique, serotinous, persistent, from 2 to 3½ inches long, their scales armed with stout incurved spines 30. P. MURICATA.

Leaves slender, dark blue-green, in 2 or in 3-leaved clusters, from 3 to 5 inches in length; cones ovate or oblong-conical, from 1½ to 2½ inches long, their scales armed with minute slender prickles . . . . . 31. P. ECHINATA.

Leaves stout, falcate, divergent, dark gray-green, from ¾ to 1¼ inch in length; cones oblong-conical, oblique, usually erect, incurved, from 1½ to 2 inches long, their scales furnished with minute incurved often deciduous prickles . . . . . 32. P. DIVARICATA.

Resin ducts of the leaves internal.

Australes. Cones subterminal or lateral, their scales conspicuously umbonate; leaves in 3, or in 2 and 3-leaved clusters; fibro-vascular bundles 2.

Cones subterminal.

Leaves slender, dark green, in 3-leaved clusters, from 8 to 18 inches in length; scales of the branch-buds silvery white; cones elongated-conical, from 6 to 10 inches long, their scales armed with short stout recurved spines . . . . . 33. P. PALUSTRIS.

Cones lateral.

Leaves stout, dark green, in 2 and 3-leaved clusters, from 8 to 12 inches in length; cones ovate or elongated-conical, from 3 to 6½ inches long, dark brown and lustrous, their scales armed with short slender prickles . . . . . 34. P. HETEROPHYLLA.

PINUS STROBUS.

White Pine.

LEAVES in 5-leaved clusters, slender, glaucous, 3 or 4 inches in length. Cones from 4 to 6 inches long.

Pinus Strobus, Linnæus, *Spec.* 1001 (1753). — Miller, *Dict.* ed. 8, No. 13. — Muenchhausen, *Hausv.* v. 221. — Du Roi, *Harbk. Baumz.* ii. 57. — Moench, *Bäume Weiss.* 70; *Meth.* 365. — Schoepf, *Mat. Med. Amer.* 142. — Evelyn, *Silva*, ed. Hunter, i. 274, t. — Wangenheim, *Nordam. Holz.* 1, t. 1, f. 1. — Castiglioni, *Viag. negli Stati Uniti*, ii. 312. — Willdenow, *Berl. Baumz.* 213; *Spec.* iv. pt. i. 501; *Enum.* 989. — Michaux, *Fl. Bor.-Am.* ii. 205. — Borkhausen, *Handb. Forstbot.* i. 440. — Lambert, *Pinus*, i. 31, t. 22. — Poiret, *Lamarck Dict.* v. 341; *Ill.* iii. 369, t. 786, f. 3. — Persoon, *Syn.* ii. 579. — Desfontaines, *Hist. Arb.* ii. 612. — Du Mont de Courset, *Bot. Cult.* ed. 2, vi. 462. — Michaux, f. *Hist. Arb. Am.* i. 103, t. 10. — Stokes, *Bot. Mat. Med.* iv. 435. — *Nouveau Duhamel*, v. 249, t. 76. — Bigelow, *Fl. Boston.* 234. — Pursh, *Fl. Am. Sept.* ii. 644. — Nuttall, *Gen.* ii. 223; *Sylva*, iii. 118. — Hayne, *Dendr. Fl.* 175. — Elliott, *Sk.* ii. 638. — Lejeune, *Rev. Fl. Spa*, 200. — Jaume St. Hilaire, *Traité des Arbres Forestiers*, t. 62, 63. — Richard, *Comm. Bot. Conif.* 60, t. 12, f. 2. — Audubon, *Birds*, t. 39. — Dietrich, *Forst. Fl.* i. t. — Forbes, *Pinetum Woburn.* 83. — Antoine, *Conif.* 43, t. 20, f. 3. — Link, *Handb.* ii. 477; *Linnæa*, xv. 514. — Hooker, *Fl. Bor.-Am.* ii. 161 (excl. syn. *Pinus monticola*). — Torrey, *Fl. N. Y.* ii. 228. — Spach, *Hist. Vég.* xi. 394. — De Chambray, *Traité Arb. Rés. Conif.* 262, t. 4, 5, f. 8. — Emerson, *Trees Mass.* 60; ed. 2, i. 73, t. — Endlicher, *Syn. Conif.* 146. — Gihoul, *Arb. Rés.* 35, t. 5. — Knight, *Syn. Conif.* 34. — Lindley & Gordon, *Jour. Hort. Soc. Lond.* v. 215. — Lawson & Son, *List No. 10, Abietineæ*, 26. — Dietrich, *Syn.* v. 396. — Darlington, *Fl. Cestr.* ed. 3, 290. — Gordon, *Pinetum*, 239. — Courtin, *Fam. Conif.* 71. — Chapman, *Fl.* 434. — Curtis, *Rep. Geolog. Surv. N. Car.* 1860, iii. 25. — Schlechtendal, *Linnæa*, xxxiii. 395. — Henkel & Hochstetter, *Syn. Nadelh.* 92. — (Nelson) Senilis, *Pinaceæ*, 130. — Hoopes, *Evergreens*, 136, f. 19. — Sénéclauze, *Conif.* 115. — Parlatore, *De Candolle Prodr.* xvi. pt. ii. 405. — K. Koch, *Dendr.* ii. pt. ii. 319. — Veitch, *Man. Conif.* 183. — Sargent, *Forest Trees N. Am. 10th Census U. S.* ix. 187. — Lauche, *Deutsche Dendr.* ed. 2, 116. — Regel, *Russ. Dendr.* ed. 2, pt. i. 50. — Schübeler, *Virid. Norveg.* i. 392. — Watson & Coulter, *Gray Man.* ed. 6, 490. — Mayr, *Wald. Nordam.* 199, t. 8, f. — Beissner, *Handb. Nadelh.* 288, f. 71, 72. — Masters, *Jour. R. Hort. Soc.* xiv. 240. — Hansen, *Jour. R. Hort. Soc.* xiv. 393 (*Pinetum Danicum*). — Hempel & Wilhelm, *Bäume und Sträucher*, i. 182, f. 107–109, t. 9. — Koehne, *Deutsche Dendr.* 30. — Britton & Brown, *Ill. Fl.* i. 50, f. 110.

Pinus tenuifolia, Salisbury, *Prodr.* 399 (1796).

Pinus alba Canadensis, Provancher, *Flore Canadienne*, ii. 554 (1862).

A tree, usually growing under favorable conditions to a height of one hundred or one hundred and twenty feet, with a trunk from three to four feet in diameter, or, exceptionally, to the height of two hundred and fifty feet, with a trunk six feet in diameter,[1] and with long stout tapering horizontal durable roots[2] clothed with thick gray bark covered by irregular rectangular plate-like scales, and in old

[1] "An. 1736, near the Merrimack River a little above Dunstable, was cut a white pine straight and sound, seven feet eight inches in diameter at the butt-end." (Douglas, *A Summary, Historical and Political, of the First Planting, Progressive Improvements, and Perfect State of the British Settlements in North America*, ii. 53.)

Dwight speaks of "white pine 6 feet in diameter and frequently 250 feet in height," and reports a tree in Lincoln, New Hampshire, of which he had heard, two hundred and sixty feet high (*Travels*, 136).

According to Williamson, "the White Pine has been seen 6 feet in diameter at the butt and 240 feet in height, and those over 4 feet through are frequent" (*History of the State of Maine*, i. 110). This was in 1832. Such trees, if they still exist in New England, are exceedingly rare, and White Pines one hundred and fifty feet high with trunks four feet in diameter now excite astonishment and admiration. Among a number of trees in Pennsylvania recently studied by Pinchot and Graves, with a view of determining the silvicultural possibilities of the White Pine, the largest was one hundred and fifty-five feet tall, with a trunk diameter of forty-two inches at four feet six inches above the ground. This tree was three hundred and fifty-one years old, and produced a merchantable log one hundred and fourteen feet in length, the total volume of the stem being five hundred and seventy-four cubic feet and scaling three thousand three hundred and thirty-five feet board measure (*The White Pine, a Study*, 4. — See, also, for dimensions of *Pinus Strobus* in Minnesota, Ayres, *Garden and Forest*, vii. 148).

[2] There has been a common saying in New England that no one ever lived long enough to see the stump of a White Pine rot, and

age often rising above the ground near the tree into low buttresses, and furnished with few long tough pliable wand-like rootlets. During its youth the branches of the White Pine are slender and horizontal or slightly ascending, and are arranged in regular whorls, usually with five branches in a whorl, clothing the stem to the ground for many years or until destroyed by the absence of light, and forming a broad open conical head. When the tree, uncrowded by others, enjoys an abundance of light and air, the lower branches often grow to a large size, the trunk remains short and becomes much thickened at the base, and the breadth of the picturesque open head often equals the height of the stem; but as the White Pine grows naturally in the forest the lower branches die at the end of a few years, and the trunk grows tall and straight, bearing branches only near the top. When it is pressed upon by trees of equal height the branches remain short and form a narrow head; but when the White Pine, which is the tallest inhabitant of the forests of northeastern America, rises above the surrounding trees, the lateral branches lengthen, sweep upward in long graceful curves, the upper ones ascending, and form a broad open irregular head.[1] The bark on young stems and branches is thin, smooth, green tinged with red, and lustrous during the summer; on fully grown trunks it is from one to two inches thick, or at the base of old trees often nearly four inches thick, and is deeply divided by shallow fissures into broad connected ridges covered with small closely appressed scales. The branchlets are slender, and when they first appear are usually coated with ferrugineous tomentum, which soon wears away; and during their first winter they are glabrous or occasionally slightly puberulous and dark orange-brown; gradually growing darker, in their second winter they are conspicuously marked by the small elevated darker colored scars which are left by the falling of the short lateral branchlets that form the base of the leaf-clusters and which do not entirely disappear until the end of four or five years. The branch-buds are ovate-oblong or slightly obovate, acuminate and abruptly contracted at the apex into short points, and are covered by ovate-lanceolate light chestnut-brown scales thin and scarious on the margins and narrowed into long slender thread-like more or less spreading tips; the terminal bud is about half an inch long and an eighth of an inch wide, and is sometimes twice as large or often not much larger than the lateral buds which surround it. The leaves are borne in clusters of five, and during the winter are inclosed in minute broadly ovate bright green buds furnished at the apex with clusters of short soft white hairs and inclosed under the scales of the branch-bud. The buds of the leaf-clusters are covered by eight scales, which lengthen with the expanding leaves, increasing in length from without inward, those of the outer ranks being at maturity ovate, rounded at the narrowed apex, dark chestnut-brown, and much shorter than those of the inner ranks, which are oblong-obovate, rounded at the apex, thin, lustrous, light chestnut-brown, often three quarters of an inch long and about an eighth of an inch broad; these scales soon fall, marking the abbreviated lateral branchlets with thin ring-like scars. The leaves are soft and slender, bluish green, and whitened on the ventral sides with from three to five conspicuous bands of stomata; they contain a single fibro-vascular bundle and from one to three, usually two, dorsal resin ducts,[2] and are sharply serrate, mucronate at the apex with pale-colored callous tips, and from three to four inches in length; they mostly turn yellow and fall in the September of their second season, but sometimes persist, especially on shaded branches, through a second winter, and then fall during the following June. The staminate flowers are oval, light brown, and about one third of an inch long, with anthers which terminate in short crests, and are surrounded by from six to eight involucral bracts. The pistillate flowers are cylindrical, subterminal, and about a quarter

the roots certainly remain sound in the ground for long periods. Formerly very durable fences were made in northern New England by standing on their edges stumps of the White Pine pulled with their roots from the ground by oxen. (See Belknap, *History of New Hampshire*, iii. 108.)

[1] For many years there has stood near the banks of the Merrimac River, in the town of Dracut, Massachusetts, a remarkable White Pine-tree with branches which are usually produced in whorls of three, and are short, slender, and nearly erect, forming a dense low round-topped symmetrical head. Plants have been raised in the Arnold Arboretum from the seeds of this tree, and a small percentage reproduce its peculiar habit.

[2] Coulter & Rose, *Bot. Gazette*, xi. 261, t. 8, f. 1.

of an inch long, with thin scales bright pinkish purple on the margins; they are raised on stout peduncles nearly as long as the flowers and clothed with the ovate acute elongated bracts persistent throughout the summer. The young cones enlarge during the spring and early summer, while their peduncles lengthen and thicken and in the autumn begin to turn downward; during the winter they are nearly horizontal or slightly pendulous, about an inch long, and light chestnut-brown, the stems being from an inch to an inch and a half in length; they begin to grow in very early spring, and when the flowers expand are from an inch and a half to an inch and three quarters long, light green, and pendulous by the recurving of their stems; they now rapidly enlarge, reaching their full size about the first of July, when they are cylindrical, acute, often more or less curved, bright green except at the points of the scales, which are dark red-brown, from four to six inches in length, and about an inch in diameter at the middle; their scales are from an inch and a quarter to an inch and a half long, about seven eighths of an inch wide, and oblong-obovate, with thin margins, the exposed portion being smooth, rounded, and only slightly thickened on the back, and furnished at the very apex with a dark resinous flat pointed umbo; the cones open and discharge their seeds during September, and fall gradually during the winter and in early spring. The seeds are narrowed at both ends, nearly a quarter of an inch long, red-brown mottled with black, and about a quarter as long as the wings, with a thin crustaceous coat produced into a narrow margin; the cotyledons vary from eight to ten in number.

Pinus Strobus is distributed from Newfoundland and the northern shore of the Gulf of St. Lawrence to the northward of Lake St. John and the head-waters of Moose River, and westward to Lake Nipigon and the valley of the Winnipeg River;[1] southward it ranges through the northern states to southern Pennsylvania, the southern shore of Lake Michigan[2] and the banks of the Illinois River,[3] Illinois, the valley of the Iowa River in central Iowa,[4] and along the Alleghany Mountains to eastern Kentucky and Tennessee, and to northern Georgia. Common in Newfoundland and the eastern provinces of Canada, the White Pine is rare and of small size in the country north of Lake Superior and on the Nipigon River; it is scattered over the region between Lake Superior and the Winnipeg River and in the neighborhood of Lonely Lake, and grows to its largest size and greatest perfection in the valley of the St. Lawrence River, in northern New England, and in the region south of the Great Lakes. Sometimes on sandy drift it forms nearly pure forests, but more often it is found in groves, a few acres in extent, scattered through the forests of deciduous-leaved trees, on fertile well-drained soil, where its roots can reach abundant and constant moisture. Less commonly it grows on slight elevations and ridges surrounded by swamps, or along their borders and the banks of streams, on river flats overflowed during part of the year, and occasionally in swamps, where it does not reach a large size or produce valuable timber. South of Pennsylvania and of central Michigan and Minnesota it is smaller, and less abundant and valuable.

The wood of *Pinus Strobus* is light, soft, not strong, close, straight-grained, very resinous,[5] easily worked, and susceptible of receiving a beautiful polish. It is light brown, often slightly tinged with red, with thin nearly white sapwood, and contains numerous thin medullary rays and thin inconspicuous bands of small summer cells. The specific gravity of the absolutely dry wood is 0.3854, a cubic foot weighing 24.02 pounds. It is manufactured into lumber, shingles, and laths, and is largely used in construction and cabinet-making, for the interior finish of buildings, in the manufacture of matches and woodenware, for the masts and spars of vessels, and for many domestic purposes.[6] The bark of the

[1] Brunet, *Cat. Vég. Lig. Can.* 57. — Bell, *Rep. Geolog. Surv. Can.* 1879–80, 49°. — Macoun, *Cat. Can. Pl.* 464.

[2] Hill, *Garden and Forest*, iv. 304.

[3] A small indigenous grove of *Pinus Strobus* occurs at Starving Rock near La Salle in La Salle County.

[4] In Iowa *Pinus Strobus* grows near Davenport on the Mississippi River, and is sparingly scattered through the central part of the state, at least as far west as Steamboat Rock on the Iowa River, where it was noticed in 1894 by Mr. S. R. Fitz, whose specimens from this locality are preserved in the herbarium of the Arnold Arboretum.

[5] Mayr found that the wood of *Pinus Strobus* stands at the head of all conifers in the amount of resin, 6.07 per cent., which it contains (*Popular Science Monthly*, xxviii. 682).

[6] The so-called pumpkin pine is the close-grained satiny and very valuable wood of large trees which have grown to a great

stem and roots and the leaves contain tannin.[1] From the bark is obtained the compound syrup of white pine, now largely used in the United States as an expectorant.[2] Coniferin, a glucoside, sometimes employed commercially in the manufacture of vanillin, is obtained from the cambium layer of *Pinus Strobus* and from that of a few other conifers.[3]

During the seventeenth century the value of the White Pine as a timber-tree had been recognized by the settlers on the north Atlantic coast;[4] and before the middle of the sixteenth the wood, on account of its reputed medicinal value,[5] had been carried to Europe by French navigators. The White Pine was first described by Plukenet[6] in 1696, and was cultivated by the Duchess of Beaufort[7] in 1705 at Badminton.[8]

age in rich, well-drained soil and have been favored with abundant air. Such trees are usually scattered singly through forests of deciduous-leaved trees, and are nowhere abundant.

[1] Bastin & Trimble, *Am. Jour. Pharm.* lxviii. 28.

[2] Sherwin, *Am. Jour. Pharm.* lxviii. 233.

[3] Hartig, *Jahrb. Forst.* i. 263. — Kubel, *Jour. Prakt. Chem.* xcvii. 243. — Tiemann & Haarmann, *Berichte Deutsch. Chem. Gesell.* vii. 608 (*Ueber das Coniferin und seine Umwandlung in das aromatische Princip der Vanille*). — *U. S. Dispens.* ed. 16, 1487.

[4] "Yellow and white pine timber, in all their varieties, is abundant here, and we have heard the Northerners say (who reside here) that the pine is as good here as the pine of Norway. But the pine does not grow as well near the salt water, except in some places. Inland, however, and high up the rivers, it grows in large forests, and it is abundant, and heavy enough for masts and spars for ships." (*Coll. N. Y. Hist. Soc.* ser. 2, i. 151 [Adrien Van der Donck, *Description of the New Netherlands*].)

"*Board Pine*, is a very large tree two or three Fadom about." (Josselyn, *New England Rarities*, 61.)

"The Pine-Tree challengeth the next place, and that sort which is called Board-pine is the principal, it is a stately large Tree, very tall, and sometimes two or three fadom about: of the body the *English* make large *Canows* of 20 foot long, and two foot and a half over, hollowing of them with an Adds, and shaping of the outside like a Boat. Some conceive that the wood called Gopher in Scripture, of which *Noah* made the *Ark*, was no other than Pine, *Gen.* 6, 14. The bark thereof is good for Ulcers in tender persons that refuse sharp medicines. The inner bark of young board-pine cut small and stampt and boiled in a Gallon of water is a very soveraign medicine for burn or scald, washing the sore with some of the decoction, and then laying on the bark stampt very soft: or for frozen limbs, to take out the fire and to heal them, take the bark of Board-pine-Tree, cut it small and stamp it and boil it in a gallon of water to Gelly, wash the sore with the liquor, stamp the bark again till it be very soft and bind it on. The Turpentine is excellent to heal wounds and cuts, and hath all the properties of *Venice* Turpentine, the Rosen is as good as Frankincense, and the powder of the dryed leaves generateth flesh; the distilled water of the green Cones taketh away wrinkles in the face being laid on with Cloths." (Josselyn, *Account of Two Voyages to New England*, 64.)

Silver shillings and coins of smaller denomination struck in the Massachusetts Colony during the latter half of the seventeenth century bore the device of a White Pine-tree. First known in Boston as Bay shillings, they were called Pine-tree money in 1680. (See Crosby, *Early Coins of America*, 56.)

In the new charter of Massachusetts Bay of 1691, which was a union of several separate grants into one legislature and jurisdiction, "all trees fit for masts of 24 inches diameter and upwards 12 inches from the ground, growing upon land not heretofore granted to any private persons, are reserved to the crown; penalty for cutting any such reserved trees 100*l.* sterl. per tree;" and by an act of the British Parliament, anno 1722, this clause is extended: "That after Sept. 21, 1722, in New England, New York, and New Jersey in America, no person shall cut or destroy any white pine trees, not growing in any township or its bounds, without his majesty's licence; on pain to forfeit for every white pine tree, of the growth of 12 inches diameter and under, at 3 foot from the earth, 5*l.* sterl. for every such tree from 12 to 18 inches, 10*l.*, from 18 to 24 inches, 20*l.*, from 24 and upwards, 50*l.*, to be sued before the judge of admiralty: and all white pine trees, masts or logs made of such trees, which shall be found cut or falled without the King's licence, shall be forfeited and seized for the use of the crown. By an act of parliament 1729, the penalty in this clause of the charter is confirmed; and the act of 1722 is extended to all the British provinces in America; and confines the exception to the property of private persons only, notwithstanding they grow within the limits of any township." (Douglas, *A Summary, Historical and Political, of the First Planting, Progressive Improvements, and Present State of the British Settlements in North-America*, i. 379.)

In 1719 the surveyor-general of Maine caused Pine-trees fit for masts to be marked with the letter R, in order to protect them for royal use (Williamson, *History of the State of Maine*, ii. 98).

When Maine was admitted into the Union in 1820 a White Pine as the noblest inhabitant of its forests, was made the central figure in the seal and arms of the new state.

[5] Belon (*Arb. Conif.* 21) satisfied himself of the worthlessness of this wood for medical purposes; but in his investigations he found in the Royal Nurseries at Fontainebleau a single young specimen of a five-leaved Pine, very like *Pinus Cembra*, which he called the Pinaster, but with "folia exiliora." This little tree with thin leaves Dr. Bolle believes to have been the White Pine; and it is not improbable that this tree, which could hardly have escaped the attention of the earliest European navigators in Canadian waters, was taken to France with the Arbor Vitæ cultivated at Fontainebleau before the middle of the sixteenth century. (See Bolle, *Gartenflora*, 1890, 434 [*Wann erscheint die Weymouthskiefer zuerst in Europa?*]. — *Garden and Forest*, iii. 536.)

[6] *Pinus Virginiana Conis longis non* (*ut in vulgari*) *echinatis, Alm. Bot.* 297.

Pinus Americana quinis ex uno folliculo setis, longis, tenuibus triquetris, ad unum angulum, per totam longitudinem minutissimis crenis asperatis, Plukenet, *Amalth. Bot.* 171.

Pinus foliis longissimis ex una theca quinis: The White Pine Tree nostratibus, Colden, *Act. Hort. Ups.* 1743, 229 (*Pl. Novebor.*).

Pinus Canadensis quinquefolia, floribus albis, conis oblongis & pendulis, squamis Abieti fere similis, Duhamel, *Traité des Arbres*, ii. 127.

Pinus foliis quinis cortice glabro, Clayton, *Fl. Virgin.* ed. 2, 152.

[7] See ix. 19.

[8] Plukenet, *Amalth. Bot.* 171. — Aiton, *Hort. Kew.* iii. 369. — Loudon, *Arb. Brit.* iv. 2280, f. 2193–2196.

Pinus Strobus at once became popular with English planters

The most valuable timber-tree of northeastern America, *Pinus Strobus* has played a conspicuous part in the material development of the United States and Canada. Great fleets of vessels and long railroads have been built to transport the lumber sawed from its mighty trunks; and men have grown rich by destroying it, building cities to supply the needs of their traffic, and seeing them languish as the forests disappear. Fifty years ago the pineries of Maine and lower Canada, of northern New York, of Pennsylvania, Michigan, Wisconsin, and Minnesota, contained stores of white pine which were believed to be inexhaustible; but the best has already been cut, and the great trees which were once the pride of the northern forest no longer exist. The White Pine, however, is a tree of strong vitality and under favorable conditions reproduces itself freely, especially on New England hills which agriculture, weary of a hopeless struggle against difficult conditions, has given back to the forest.[1]

The White Pine has been largely used in the United States and Europe in the decoration of parks and gardens, and in the north Atlantic states no other cone-bearing tree surpasses it in beauty, rapidity of growth, and durability.[2] A number of forms of abnormal habit or with variously colored leaves have appeared in European nurseries and are occasionally found in gardens.[3]

The most beautiful Pine-tree of eastern America, our sylvan scenery owes the peculiar charm which distinguishes it from that of all other parts of the world to the wide-spreading dark green crowns of the White Pine, raised on stately shafts high above the level of the forest roof and breaking the monotony of its sky-line.

The specific name given to the White Pine by Linnæus is that of an incense-bearing tree of ancient Persia, the identity of which is now unknown.[4]

through the example of Thomas, Viscount Weymouth, second Marquis of Bath, who planted it on his estate at Longleat; and it is now almost universally called in Europe the Weymouth Pine. The seeds produced in these early plantations were distributed over England, where, at one time, it was largely planted, but, although the White Pine flourishes in some favorite localities in Great Britain (see Goldring, *The Garden*, xxxi. 404. — Webster, *The Garden*, xxxiii. 522), it is less successful there than in northern and central Germany and northern Italy, and in southern Scandinavia, where large specimens of this tree exist. (See Hansen, *Garden and Forest*, v. 230.)

The White Pine grows with the greatest vigor in northern Italy and in many parts of northern and central Germany, where large plantations have been made of this tree. In central Europe it has been found to grow more rapidly than any of the indigenous Conifers, with the exception, perhaps, of the Larch, and to bear while young better than most Pines the partial shade of other trees; it supports without injury the severest cold of winter, and is not hurt by the frosts of spring or early autumn; its abundant and soft leaves, which quickly decay after falling, make it valuable for the improvement of worn-out soils, and it has been successfully used to clothe the ground under thin Oak-trees in young plantations. But the wood produced in Europe, although it has been shown to possess nearly the same qualities which distinguish it in its native forests, has never been highly esteemed, and the White Pine has not yet received from European silviculturists the attention its success after long trial and under various conditions seems to justify (Hartig, *Forst. Culturpfl. Deutschl.* 81, t. 8. — Fiscali, *Deutsch. Forstcult.-Pfl.* 59, t. 2, f. 7–13. — Nördlinger, *Forstbot.* 401, f. — Mathieu, *Fl. Forestière*, ed. 3, 546. — Lorentz, *Culture des Bois*, ed. 6, 156. — Willkomm, *Forst. Fl.* 153. — Mayr, *Garden and Forest*, i. 10. — Wesmael, *Garden and Forest*, iii. 494. — R. Hartig, *Forst.-Nat. Zeit.* i. 442).

[1] Although the White Pine does not quickly or abundantly reproduce itself when fires have been allowed to consume the surface soil of the forest, it succeeds itself on land which has not suffered from fire if sufficient shade is left to protect the young and tender seedlings. In New England it is now occupying great tracts of abandoned farm-lands, and these vigorous young forests, which have sprung up on land worthless for the production of other crops, promise prosperity to these rural regions. During the year ending June 30, 1880, at least one hundred million feet of second-growth white pine were manufactured in New Hampshire and Vermont, while Maine produced nearly as much more. The manufacture of pails, boxes, and other small articles of second-growth white pine has become an important industry, and the young White Pine forests of central Massachusetts have made Winchendon, Worcester County, the great centre of this industry in the United States. (See Sargent, *Rep. Sec. Board Agric. Mass.* xxx. 276.)

A few successful attempts have been made to cultivate the White Pine in New England on a comparatively large scale, and it will probably play an important part in any silvicultural operations which may be undertaken in the northeastern United States (Lyman, *Garden and Forest*, v. 266; ix. 142. — Fernow, *Garden and Forest*, v. 609; ix. 202. — R. Douglas, *Garden and Forest*, vi. 106. — *Garden and Forest*, vii. 487).

[2] Beissner, *Handb. Nadelh.* 291. — Sudworth, *Bull.* No. 14 *Div. Forestry U. S. Dept. Agric.* 13.

[3] *Pinus Strobus nana* (Knight, *Syn. Conif.* 34 [1850]), which is the most distinct of these abnormal forms of the White Pine, is a low compact round-topped bush seldom growing more than five or six feet high, with short crowded branches and abbreviated leaves.

Pinus Strobus nivea (Carrière, *Traité Conif.* ed. 2, 400 [1867]) is characterized by denser foliage, shorter silvery white leaves, and lighter colored bark than those of the normal form.

[4] Pliny, xliº. 17.

EXPLANATION OF THE PLATES.

Plate DXXXVIII. Pinus Strobus.

1. A branch with staminate flowers, natural size.
2. A staminate flower, enlarged.
3. Diagram of the involucre of the staminate flower.
4. An anther, side view, enlarged.
5. An anther, front view, enlarged.
6. A branch with young cone and pistillate flowers, natural size.
7. A pistillate flower, enlarged.

8 and 9. Scales of a pistillate flower, lower side, with their bracts, enlarged.

10. A scale of a pistillate flower, upper side, with its ovules, enlarged.
11. Tip of a leaf, enlarged.
12. Cross section of a leaf, magnified fifteen diameters.
13. A cluster of young leaves with its sheath.

Plate DXXXIX. Pinus Strobus.

1. An autumn branch with young cones, natural size.
2. A fruiting branch, natural size.
3. A cone-scale, lower side, natural size.
4. A cone-scale, upper side, with its seeds, natural size.
5. A seed, enlarged.
6. A seed with its wing, natural size.
7. Vertical section of a seed, enlarged.
8. An embryo, enlarged.
9. A cluster of leaves, natural size.
10. A cluster of winter branch-buds, natural size.
11. A seedling plant, natural size.

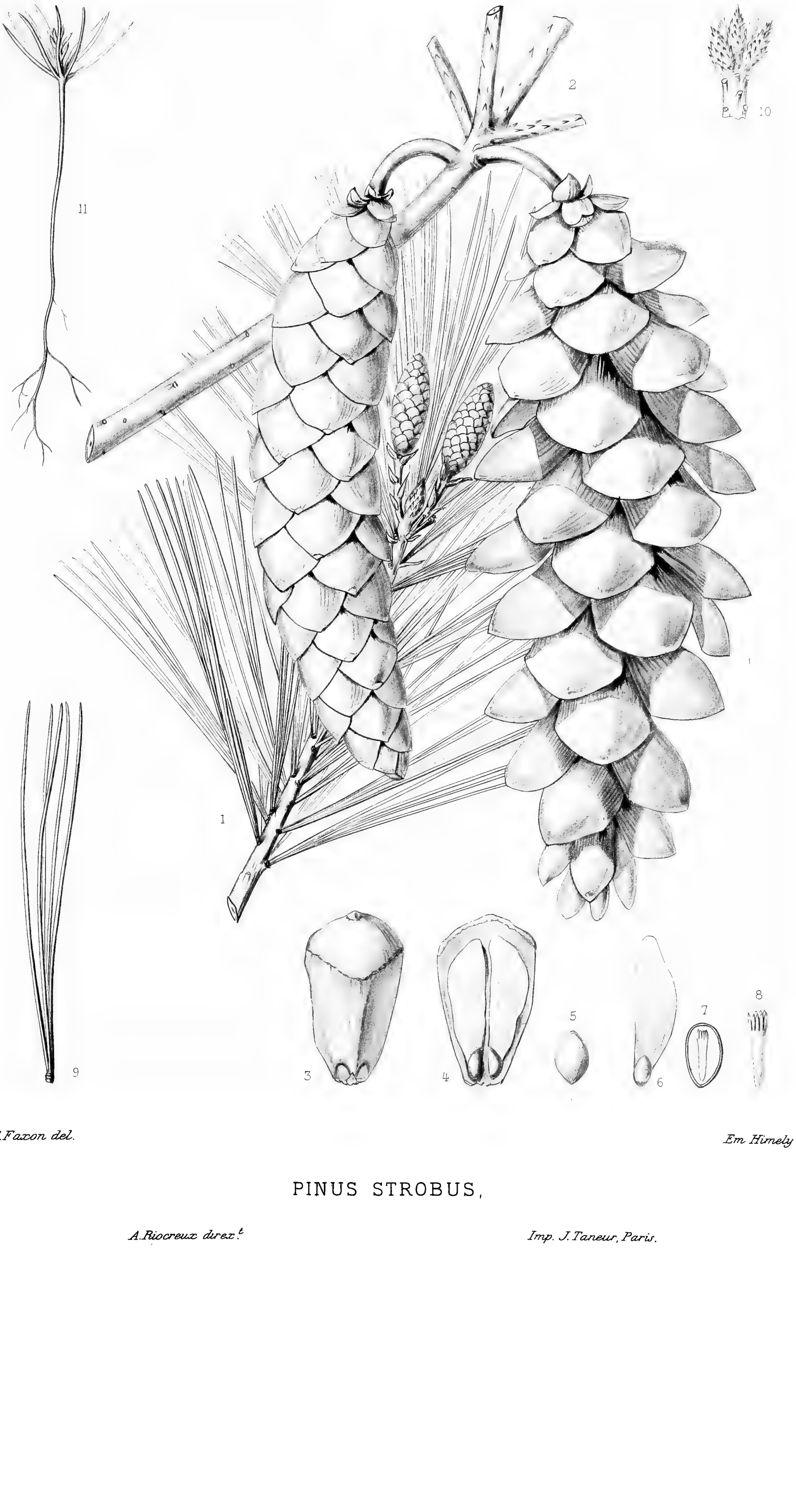
C.E.Faxon del.

Em.Himely sc.

PINUS STROBUS, L.

A.Riocreux direx.t

Imp. J.Taneur, Paris.



C.E.Faxon del. Em Himely sc.

PINUS STROBUS,

A.Riocreux direx.t Imp. J.Taneur, Paris.

PINUS MONTICOLA.

White Pine.

LEAVES in 5-leaved clusters, thick, rigid, from $1\frac{1}{2}$ to 4 inches in length. Cones from 5 to 11 inches long.

Pinus monticola, D. Don, *Lambert Pinus*, iii. t. (1837). — Loudon, *Arb. Brit.* iv. 2291, f. 2208, 2209. — Forbes, *Pinetum Woburn.* 81, t. 31. — Antoine, *Conif.* 40, t. 18, f. 3. — Hooker & Arnott, *Bot. Voy. Beechey*, 394. — Endlicher, *Syn. Conif.* 148. — Lawson & Son, *List No. 10, Abietineæ*, 26. — Dietrich, *Syn.* v. 396. — Carrière, *Traité Conif.* 305. — Gordon, *Pinetum*, 233. — Courtin, *Fam. Conif.* 71. — Cooper, *Pacific R. R. Rep.* xii. pt. ii. 27; *Am. Nat.* iii. 410. — Lyall, *Jour. Linn. Soc.* vii. 141. — Henkel & Hochstetter, *Syn. Nadelh.* 94. — (Nelson) Senilis, *Pinaceæ*, 120. — Hoopes, *Evergreens*, 135. — Bolander, *Proc. Cal. Acad.* iii. 318. — Sénéclauze, *Conif.* 114. — Parlatore, *De Candolle Prodr.* xvi. pt. ii. 405. — K. Koch, *Dendr.* ii. pt. ii. 322. — Hall, *Bot. Gazette*, ii. 94. — Engelmann, *Brewer & Watson Bot. Cal.* ii. 123. — Veitch, *Man. Conif.* 181, f. 41. — Lawson, *Pinetum Brit.* i. 69, f. 1–10. — Kellogg, *Forest Trees of California*, 45. — Sargent, *Forest Trees N. Am.* 10*th Census U. S.* ix. 187. — Lauche, *Deutsche Dendr.* ed. 2, 116. — Schübeler, *Virid. Norveg.* i. 393. — Lemmon, *Rep. California State Board Forestry*, ii. 70, 79, t. (*Pines of the Pacific Slope*); *West-American Cone-Bearers*, 22. — Steele, *Proc. Am. Pharm. Assoc.* 1889, 232 (*The Pines of California*). — Mayr, *Wald. Nordam.* 331, t. 7, f. — Beissner, *Handb. Nadelh.* 293. — Masters, *Jour. R. Hort. Soc.* xiv. 235. — Hansen, *Jour. R. Hort. Soc.* xiv. 376 (*Pinetum Danicum*). — Merriam, *North American Fauna*, No. 7, 339 (*Death Valley Exped.* ii.). — Coville, *Contrib. U. S. Nat. Herb.* iv. 222 (*Bot. Death Valley Exped.*). — Koehne, *Deutsche Dendr.* 31.

Pinus Strobus, β monticola, Nuttall, *Sylva*, iii. 118 (1849).

Pinus porphyrocarpa, A. Murray, *Lawson Pinetum Brit.* i. 83, f. 1–8 (1866).

Pinus Grozelieri, Carrière, *Rev. Hort.* 1869, 126, f. 31.

Pinus monticola, var. **minima**, Lemmon, *Rep. California State Board Forestry*, ii. 70, 80 (*Pines of the Pacific Slope*) (1888).

Pinus monticola, var. **porphyrocarpa**, Masters, *Jour. R. Hort. Soc.* xiv. 235 (1892).

Pinus monticola, var. **digitata**, Lemmon, *West-American Cone-Bearers*, 22 (1895).

A tree, frequently one hundred feet in height, with a tall straight trunk four or five feet in diameter, or occasionally one hundred and fifty feet high, with a trunk seven or eight feet in diameter, and comparatively slender spreading somewhat pendulous branches which in youth clothe the stem to the ground and form a narrow open pyramid, the symmetry of which is often broken in old age by the greater development of one or two of the upper branches. The bark of young stems and branches is thin, smooth, and light gray, and on fully grown trunks is from three quarters of an inch to an inch and a half in thickness, and divided into small nearly square plates by deep regular longitudinal and cross fissures, covered on the surface by small closely appressed purple scales, which are often worn away by mountain storms, leaving exposed the bright cinnamon-red inner bark. The branches are stout and tough, and when they first appear are clothed with rusty pubescence; during their first winter they are dark orange-brown and puberulous, becoming dark red-purple and glabrous in their second season, and for five or six years bearing the conspicuous scars of the fallen bud-scales. The winter branch-buds are broadly ovate, acute, from one third to one half of an inch in length, and covered by ovate-lanceolate light chestnut-brown scales scarious on the margins and long-pointed and spreading at the apex. The leaves are borne in clusters of five, and during the winter are inclosed in minute ovate compressed pale green buds coated at the apex with hoary pubescence; their scales lengthen with the young leaves, and when fully grown are thin, lustrous and light chestnut-brown, or white, forming a sheath about half an inch in length, and soon deciduous. The leaves are thick, rigid, blue-green and glaucous, from an inch and a half to four inches in length, with from two to six rows of ventral stomata and sometimes with also one or two dorsal rows, a single fibro-vascular bundle, and strengthening

cells under nearly the whole epidermis; they contain usually two but sometimes only a single dorsal resin duct,[1] and are serrate with small minute teeth; the leaves fall partly during their third and partly during their fourth season. The staminate flowers are oval, about a third of an inch long, with anthers which terminate in short crests or knobs, and are surrounded by eight involucral bracts. The pistillate flowers are clustered, oblong-cylindric, and about half an inch in length, with thin scales, and are raised on stout peduncles nearly as long as the flowers and clothed with ovate-lanceolate long-pointed chestnut-brown bracts conspicuously keeled on the back, one third of an inch in length, and persistent during the season. In the autumn the young cones are from three quarters of an inch to nearly an inch long, brown tinged with red, erect on stout peduncles usually an inch in length; they become reflexed when they begin to grow in early spring, and ripen and shed their seeds late in the summer or in the early autumn, when they are light green,[2] cylindrical, pointed, often curved, from five to eleven inches long and about two inches thick, and are borne on stout incurved peduncles from an inch to an inch and a half in length; their scales are thin, oblong-obovate, from an inch to an inch and a half long, about three quarters of an inch wide, and slightly thickened and smooth toward the apex, which is gradually narrowed, rounded, and tipped with a small slightly thickened pointed dark umbo; the cones fall during the winter and spring, the exposed portions of the scales having become light reddish brown and their bases dark dull red in the autumn. The seeds are narrowed at both ends, one third of an inch long and about one third the length of the pointed wings, and are covered by a pale red-brown coat mottled with black, and produced into a narrow obscure wing-like margin; the cotyledons vary from six to nine in number.

The western White Pine is distributed through mountain forests from the basin of the Columbia River in southern British Columbia to Vancouver Island,[3] southward along the western slopes of the Rocky Mountains to northern Montana, and to the Bitter Root Mountains of Idaho, westward along the mountain ranges of northern Idaho and Washington, reaching the sea-level near the shores of the Straits of Fuca, and southward along the Cascade Mountains and the Washington and Oregon coast ranges, extending eastward in Oregon to the high mountains east of Goose Lake,[4] and southward along both slopes of the California Sierras to the ridge between Little Kern and Kern Rivers in latitude 36° 25′.[5] In northern Idaho the western White Pine grows to its largest size, and is most abundant, often forming an important part of the forest at elevations of from two thousand to two thousand five hundred feet above the sea on the bottom-lands of streams tributary to Lake Pend Oreille; farther east, in Montana, it is less abundant and smaller; in the interior of British Columbia it is not abundant, although it sometimes is large; it is scattered in considerable numbers through the coniferous forests of the coast ranges of British Columbia and through the interior of Vancouver Island; and it is not rare on the Cascade Range, where it ascends to elevations of five or six thousand feet, nor on the California Sierras, first appearing singly or in small groups along the upper margin of the Fir forest, and attaining its noblest dimensions in California at elevations of about ten thousand feet above the sea, where trees ninety feet high, with trunks five or six feet in diameter, sometimes occur, and resist for centuries, with their massive trunks and short contorted branches, the fiercest Sierra gales.[6]

The wood of *Pinus monticola* is very light, soft, not strong, and close and straight-grained; it is light brown or red, with thin nearly white sapwood, and contains numerous obscure medullary rays. The specific gravity of the absolutely dry wood is 0.3908, a cubic foot weighing 24.35 pounds. It is sometimes manufactured into lumber, especially in northern Idaho and Montana, and is used for the same purposes as white pine in the eastern states.

[1] Coulter & Rose, *Bot. Gazette*, xi. 261.

[2] A form with purple cones and rather broader leaves, known only from a tree cultivated in Scotland, is the *Pinus porphyrocarpa* of A. Murray.

[3] G. M. Dawson, *Can. Nat.* n. ser. ix. 328. — Macoun, *Cat. Can. Pl.* 464.

[4] During the summer of 1896 Dr. E. Hart Merriam found *Pinus monticola* growing on the high peaks of the Warner Range east of Goose Lake, Oregon.

[5] *Teste* Lieutenant M. F. Davis, U. S. Army.

[6] See portrait of *Pinus monticola* on the mountains above the Yosemite Valley, California, in *Garden and Forest*, v. f. 1.

Pinus monticola was discovered by David Douglas[1] in 1831 on the mountains near the Columbia River, and was introduced by him into English gardens. It is perfectly hardy in central and northern Europe, where large specimens may now be seen;[2] and in the eastern United States it is hardy, and produces its cones as far north, at least, as eastern Massachusetts. In eastern plantations it grows more slowly, and is less beautiful than *Pinus Strobus*, and is hardly distinct enough in habit from this species to make its cultivation as an ornamental tree desirable.

[1] See ii. 94.

[2] Fowler, *Gard. Chron.* 1872, 1071.

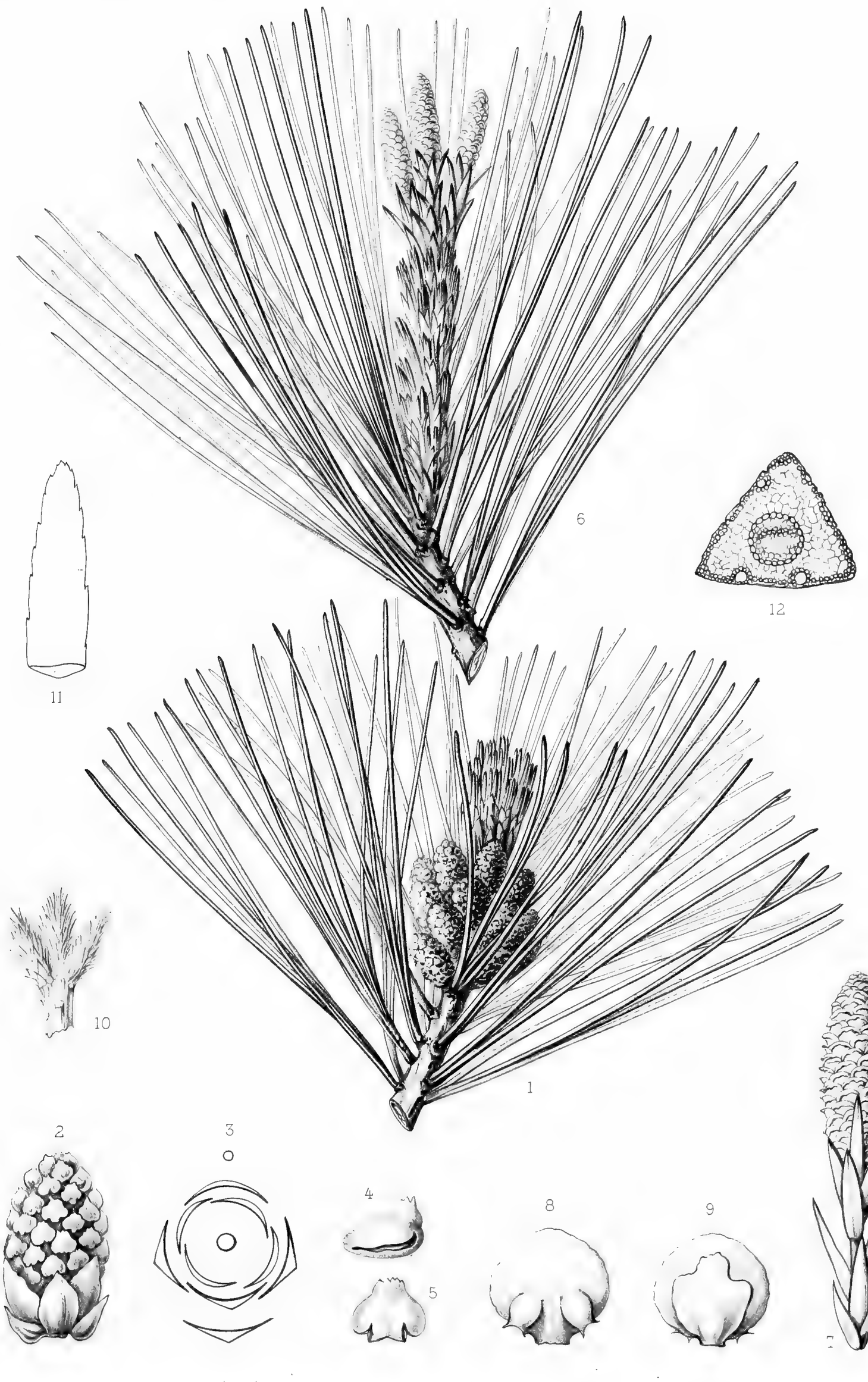
EXPLANATION OF THE PLATES.

PLATE DXL. PINUS MONTICOLA.

1. A branch with staminate flowers, natural size.
2. A staminate flower, enlarged.
3. Diagram of the involucre of the staminate flower.
4. An anther, side view, enlarged.
5. An anther, front view, enlarged.
6. A branch with pistillate flowers, natural size.
7. A pistillate flower with its peduncle, enlarged.
8. A scale of a pistillate flower, upper side, with its ovules, enlarged.
9. A scale of a pistillate flower, lower side, with its bract, enlarged.
10. A cluster of winter branch-buds, natural size.
11. Tip of a leaf, enlarged.
12. Cross section of a leaf, magnified fifteen diameters.

PLATE DXLI. PINUS MONTICOLA.

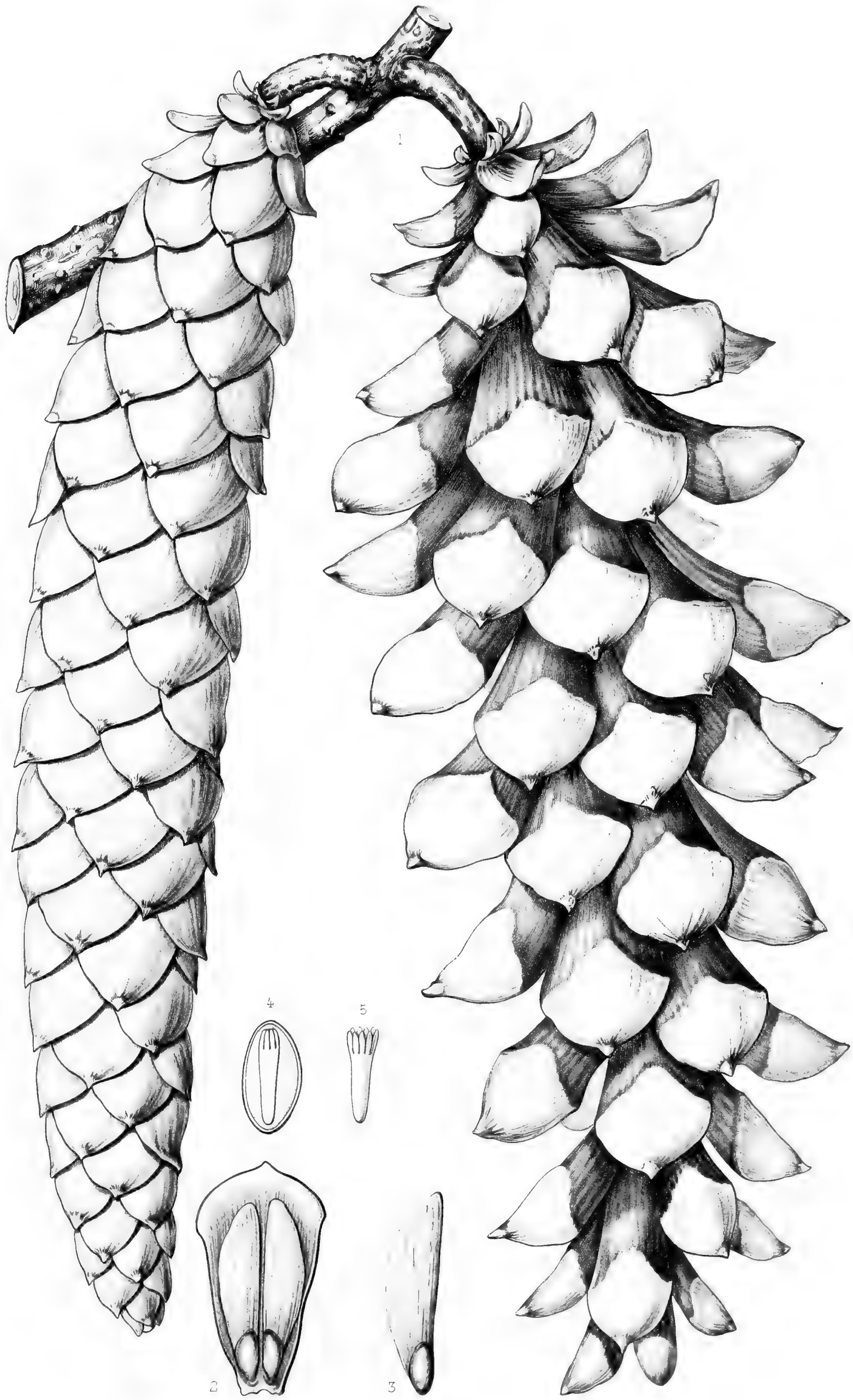
1. A portion of a branch with cones, natural size.
2. A cone-scale, upper side, with its seeds, natural size.
3. A seed, natural size.
4. Vertical section of a seed, enlarged.
5. An embryo, enlarged.



C.E. Faxon del. J. Migneaux sc.

PINUS MONTICOLA, D. Don.

A. Riocreux direx.t Imp. J. Taneur, Paris.



C.E. Faxon del. J. Migneaux sc.

PINUS MONTICOLA, D. Don.

A. Riocreux direx.t Imp. J. Taineur, Paris.

PINUS LAMBERTIANA.

Sugar Pine.

LEAVES in 5-leaved clusters, stout, rigid, from $3\frac{1}{2}$ to 4 inches in length. Cones from 12 to 18 inches long.

Pinus Lambertiana, Douglas, *Trans. Linn. Soc.* xv. 500 (1827). — D. Don, *Lambert Pinus*, iii. t. 16, 17. — Forbes, *Pinetum Woburn.* 77, t. 30. — Hooker, *Fl. Bor.-Am.* ii. 161. — Antoine, *Conif.* 41, t. 19. — Hooker & Arnott, *Bot. Voy. Beechey*, 394. — Spach, *Hist. Vég.* xi. 397. — De Chambray, *Traité Arb. Rés. Conif.* 346. — Endlicher, *Syn. Conif.* 150. — Nuttall, *Sylva*, iii. 122, t. 114. — Lindley & Gordon, *Jour. Hort. Soc. Lond.* v. 215. — Lawson & Son, *List No. 10, Abietineæ*, 25. — Dietrich, *Syn.* v. 396. — Carrière, *Traité Conif.* 307. — J. M. Bigelow, *Pacific R. R. Rep.* iv. pt. v. 21. — Torrey, *Pacific R. R. Rep.* iv. pt. v. 141; *Bot. Mex. Bound. Surv.* 210; *Ives' Rep.* pt. iv. 28. — Newberry, *Pacific R. R. Rep.* vi. pt. iii. 42, 90, f. 14. — Gordon, *Pinetum*, 228. — Courtin, *Fam. Conif.* 70. — A. Murray, *Trans. Bot. Soc. Edinburgh*, vi. 369. — Lawson, *Pinetum Brit.* i. 47, t. 7, f. 1–7. — Bolander, *Proc. Cal. Acad.* iii. 226, 317. — Henkel & Hochstetter, *Syn. Nadelh.* 95. — (Nelson) Senilis, *Pinaceæ*, 115. — Hoopes, *Evergreens*, 134. — Sénéclauze, *Conif.* 114. — Parlatore, *De Candolle Prodr.* xvi. pt. ii. 406. — K. Koch, *Dendr.* ii. pt. ii. 323. — Engelmann, *Brewer & Watson Bot. Cal.* ii. 123. — Veitch, *Man. Conif.* 179. — Kellogg, *Trees of California*, 47. — Sargent, *Forest Trees N. Am. 10th Census U. S.* ix. 188. — Lauche, *Deutsche Dendr.* ed. 2, 117. — Hooker, f. *Gard. Chron.* n. ser. xxiii. 11, f. 1. — *Gard. Chron.* ser. 3, i. 772, f. 144. — Schübeler, *Virid. Norveg.* i. 390. — Lemmon, *Rep. California State Board Forestry*, ii. 70, 80, t. (*Pines of the Pacific Slope*); *West-American Cone-Bearers*, 21, t. 2. — Steele, *Proc. Am. Pharm. Assoc.* 1889, 232 (*The Pines of California*). — Mayr, *Wald. Nordam.* 324, t. 7, f. — Beissner, *Handb. Nadelh.* 294. — Masters, *Jour. R. Hort. Soc.* xiv. 231. — Hansen, *Jour. R. Hort. Soc.* xiv. 366 (*Pinetum Danicum*). — Merriam, *North American Fauna*, No. 7, 340 (*Death Valley Exped.* ii.). — Coville, *Contrib. U. S. Nat. Herb.* iv. 222 (*Bot. Death Valley Exped.*). — Koehne, *Deutsche Dendr.* 31.

Pinus Lambertiana, var. **minor**, Lemmon, *Rep. California State Board Forestry*, ii. 70, 83 (*Pines of the Pacific Slope*) (1888).

Pinus Lambertiana, var. **purpurea**, Lemmon, *West-American Cone-Bearers*, 22 (1895).

A tree, usually from two hundred to two hundred and twenty feet in height, with a trunk six or eight or occasionally ten or twelve feet in diameter.[1] During the first fifty years of its life the slender branches, arranged in remote regular whorls, frequently clothe the tapering stem to the ground and form an open narrow pyramid; later some of the specialized branches near the top of the tree grow more rapidly than the others, and, becoming fruitful, bend with the weight of the great cones; and long before the tree has reached maturity many of the upper branches lengthen faster than the lower ones, which eventually die from absence of light, and the tall massive trunk is surmounted with an open flat-topped crown, frequently sixty or seventy feet across, of comparatively slender branches sweeping outward and downward in graceful curves. On young stems and branches the bark is smooth and dark gray, while on old trunks it is from two to three inches in thickness, and is deeply and irregularly divided into long thick plate-like ridges covered by large loose scales which are rich purplish brown or often, on wind-swept slopes of the California Sierras, bright cinnamon-red. The branchlets are stout, and when they first appear are coated with short pale or rufous pubescence; during their first winter they are dark orange-brown and puberulous, becoming in their second year

[1] David Douglas, who discovered *Pinus Lambertiana* on the headwaters of the Umpqua River in southwestern Oregon on October 26, 1826, having previously seen the seeds on the Columbia River in the pouch of an Indian, describes a fallen tree measured by him as two hundred and forty-five feet high, with a trunk fifty-seven feet nine inches in circumference at three feet above the ground, and seventeen feet five inches in circumference at one hundred and thirty-four feet above the ground. (See *Companion Bot. Mag.* ii. 92, 106, 107, 130, 152.) It is hardly probable that a careful and conscientious man like Douglas would have exaggerated these measurements, although he attributed to some other trees also what now appears an excessive size. Sugar Pines of the size he describes are now unknown, and trunks twelve feet in diameter are uncommon.

dark brown tinged with purple, and for many years they are marked with the scars of the fallen leaf-bearing lateral branchlets. The winter branch-buds are oblong-obovate, gradually narrowed to the rounded apiculate apex, one third of an inch long, about one eighth of an inch thick, and covered by ovate acute light chestnut-brown scales scarious and erose on the margins and terminating in long loose points. The leaves are produced in clusters of five, and during the winter are inclosed in ovate compressed pale green buds. The bud-scales are ovate-lanceolate, thin, white, or light chestnut-brown on the outer ranks, and when fully grown form a close deciduous sheath about half an inch in length. The leaves are stout, rigid, sharply serrate, especially toward the apex, which is tipped with a sharp callous point, and from three to four inches long; they are dark green, and marked on each face with from two to six rows of stomata, and contain a single fibro-vascular bundle, two or sometimes three dorsal resin ducts, and occasionally one or more parenchymatous ventral ducts;[1] they fall during their second and third years. The staminate flowers are oval, pale yellow, and half an inch long, with denticulate crested anthers, and are surrounded by from ten to fifteen involucral bracts. The pistillate flowers are usually clustered, and are cylindrical, an inch in length, with thin light green scales, and are raised on stout peduncles an inch and a half long and covered by lanceolate long-pointed chestnut-brown bracts conspicuously keeled on the back and persistent during the winter. In the autumn the young cones are light red-brown, about two inches long and three quarters of an inch thick, and stand erect on peduncles from two inches to three inches and a half in length and half an inch in thickness bearing elongated bracts now often three quarters of an inch long; in early spring the peduncles become reflexed, and the cones, which are now pendulous, grow rapidly, attaining their full size in August, when they are cylindrical, often slightly curved, from eleven to eighteen or occasionally twenty-one inches in length, about three inches in breadth, and light green more or less shaded with purple on the side exposed to the sun,[2] with obovate-oblong scales from two inches to two inches and a quarter long and about an inch and a half broad across the base of the exposed portion, which is slightly thickened, smooth and rounded on the back, gradually narrowed into a rounded point and tipped with a small thin dark umbo, and becomes after the falling of the seeds light red-brown and very lustrous, while the unexposed portions of the scales turn a dull dark purple; the cones open and shed their seeds during September or October and remain on the branches during the winter, falling the following spring or during the succeeding summer and autumn. The seeds are from one half to five eighths of an inch in length, with a smooth thin and brittle dark chestnut-brown or nearly black coat, and about half as long as the firm dark brown wings, which are obtuse, and broadest below the middle, where they are about half an inch across; the cotyledons vary from thirteen to fifteen in number.

Pinus Lambertiana inhabits mountain slopes and the sides of ravines and cañons; in Oregon it is distributed from the valley of the Santiam River in Marion County,[3] southward along the Cascade Mountains and coast ranges at elevations of from two thousand five hundred to three thousand feet, sometimes descending to a thousand feet near the coast; it extends eastward across the Cascade Range to the head-waters of the Des Chutes River and the western shores of upper Klamath Lake, where it is found at an elevation of two thousand two hundred feet, reappearing on the bluffs east of Klamath Lake[4] and in Drew Valley to the westward of Goose Lake;[5] in California it inhabits the northern cross

[1] Coulter & Rose, *Bot. Gazette*, xi. 262.

[2] Lemmon (*West-American Cone-Bearers*, 22) describes the cones of his variety *purpurea* as purplish, shorter, and less attenuated toward the ends than those of the typical form. When fully exposed to the sun, however, the cones of *Pinus Lambertiana* are always more or less tinged with purple.

[3] During the autumn of 1896 *Pinus Lambertiana* was found to the northward of the Santiam River in Marion County by Mr. S. W. Gorman in sufficient quantities to be valued commercially.

[4] In 1894 Mr. John B. Leiberg found *Pinus Lambertiana* on the head-waters of the Des Chutes River east of Crescent Lake and southward along the eastern foothills of the Cascade Mountains to upper Klamath Lake and on the bluffs to the eastward of Fort Klamath.

[5] During the summer of 1896 Dr. F. V. Coville and Mr. John B. Leiberg, journeying westward from Steen Mountain in eastern Oregon, saw *Pinus Lambertiana* growing with *Pinus ponderosa* in Drew Valley, fourteen miles west of Goose Lake.

ranges, and extends southward along the high coast mountains to Sonoma County;[1] it occurs on the highest peaks of the Santa Lucia Mountains in Monterey County, where it is found at elevations of about six thousand feet and is not common, and on those of the San Rafael[2] and San Emigdio Mountains;[3] it ranges along the whole length of the western slope of the Sierra Nevada Mountains at elevations of from three to seven thousand feet, in the middle of the range occasionally crossing to its eastern slopes; it is common on the San Bernardino and San Jacinto Mountains at elevations of from four to seven thousand feet[4] and on the Cuyamaca Mountains in southern California, and finds its most southerly home on the high isolated Mt. San Pedro Martir near the middle of the peninsula of Lower California.[5] Frequently attaining a large size in southwestern Oregon, the Sugar Pine is small and comparatively rare east of the summits of the Cascade Mountains and on the California coast ranges, its true home being the western slopes of the California Sierras, where it rises over every ridge and from the sides of every cañon, and, mingled in small isolated groves with the Yellow Pine, the Douglas Fir, the Incense Cedar, and the Sequoia, and occasionally forming a considerable part of the forest, it attains its greatest size and beauty at an elevation of about seven thousand feet above the sea.

The wood of *Pinus Lambertiana* is light, soft, straight-grained, satiny, very fragrant, and easy to work; it is light reddish brown, with thin nearly white sapwood, and contains thin resinous conspicuous bands of small summer cells, numerous large prominent resin passages, and many obscure medullary rays.[6] The specific gravity of the absolutely dry wood is 0.3684, a cubic foot weighing 22.96 pounds. It is largely manufactured into lumber and used for the interior finish of buildings, for shingles,[7] doors, sashes, and woodenware, and in cooperage. A sweet sugar-like matter, to which this tree owes its popular name, exudes from the heartwood wounded by fire or the axe in the shape of irregular crisp kernels crowded together into masses of considerable size; possessing powerful diuretic properties, it can be safely eaten only in small quantities.[8]

Pinus Lambertiana was introduced into English gardens in 1831 by its discoverer,[9] David

[1] In 1895 Mr. J. R. Watson found at an elevation of about two thousand feet a small grove of *Pinus Lambertiana* near the head of the cañon of Austin Creek on Table Mountain, a part of the Shone Ranch and about ten miles northwest of Cazadero in Sonoma County, California. (See *Erythea*, iv. 152.)

[2] *Pinus Lambertiana* was collected in 1894 on the San Rafael Mountains, east of Santa Barbara, by Dr. F. Franceschi, at an elevation of five thousand feet above the sea.

[3] *Teste* Miss Alice Eastwood.

[4] S. B. Parish, *Zoë*, iv. 350.

[5] *Pinus Lambertiana* was discovered May 13, 1893, by Mr. T. S. Brandegee, on Mt. San Pedro Martir. (See *Zoë*, iv. 201, 210).

[6] The Sugar Pine under the most favorable conditions increases slowly in trunk diameter. The specimen from the northern Sierras in the Jesup Collection of North American Woods in the American Museum of Natural History, New York, is sixty-four inches in diameter inside the bark, and three hundred and fifty-eight years old, with three and five eighths inches and ninety annual layers of sapwood. A tree seven feet in diameter grown on the California Sierras was found by John Muir to be three hundred and thirty years old; one hundred and fifty feet above the ground the trunk of this tree had a diameter of three feet three inches. Other trees examined by Muir were five feet three inches in diameter, and four hundred and forty years old; three feet nine and one half inches in diameter, and four hundred and twenty-four years old; four feet eight inches in diameter, and three hundred and fifty years old; three feet six inches in diameter, and two hundred and twenty-five years old; and three feet four inches in diameter, and two hundred and fourteen years old; the trunk of this tree was two feet three inches in diameter when it was one hundred years of age.

A log of Sugar Pine measured by Gen. Henry L. Abbot in the summer of 1896, on the head-waters of Rogue River, Oregon, showed the following rate of growth:—

When 6 inches in diameter it was 40 years old.
12 inches in diameter, 67 years old.
18 inches in diameter, 87 years old.
24 inches in diameter, 111 years old.
30 inches in diameter, 191 years old.
36 inches in diameter, 270 years old.
42 inches in diameter, 346 years old.
48 inches in diameter, 423 years old.
$52\frac{4}{10}$ inches in diameter, 473 years old.
$57\frac{2}{10}$ inches in diameter, 593 years old.

The sapwood of this tree was four inches thick, with one hundred and twenty layers of annual growth.

[7] Many of the best Sugar Pines of the Sierra forests have been killed by wandering shingle-makers, who fell trees on the public domain, and, after using only the butt cuts, which often split more easily than the others, abandon the rest of the stem to rot on the ground.

[8] For the chemical composition of the sugar of *Pinus Lambertiana*, see Berthelot, *Ann. de Chim. et de Phys.* sér. 2, xlvi. 76 (*Sur quelques Matières Sucrées*, ii. *Pinite*). — Johnson, *Am. Jour. Sci.* sér. 2, xxii. 6 (*Examination of two Sugars [Panoche and Pine Sugar] from California*). — Maquenne, *Compt. Rend.* cix. 812 (*Sur un Nouveau Sucre à Noyau Aromatique*); *Ann. de Chim. et de Phys.* sér. 6, xxii. 264 (*Recherches sur la Pinite et l'Inosite Dextrogyre*). — Combes, *Compt. Rend.* cx. 46 (*Sur la Matézite et le Matézodambose*).

[9] Lewis and Clark, in the journal of their journey across the continent during the years 1804–1806 (ed. Coues, iii. 832), mention a

Douglas; and although it has proved perfectly hardy in western and central Europe, and in eastern America as far north as southern New England, it grows very slowly in cultivation, and gives little indication of assuming its true habit or attaining a large size.

The Sugar Pine, the noblest of its race, surpassing all other Pine-trees in girth and length of stem, tosses its mighty branches, bending under the weight of its long graceful pointed cones, far above the silvan roof, and with its companion, the great Sequoia, glorifies those Sierra forests that surpass in majesty all forests of coniferous trees.[1]

The specific name commemorates that of Aylmer Bourke Lambert,[2] a munificent English patron of botany.

Pine-tree with a cone sixteen or eighteen inches in length and about four inches in circumference on the north side of the Columbia River near the ocean. Judging by the size of the cone this tree must have been the Sugar Pine. No one, however, since the time of Lewis and Clark has seen *Pinus Lambertiana* growing north of the Columbia River, and their description was probably made from a cone in the possession of some of the Columbia River Indians, who were no doubt in the habit of obtaining the seeds of this tree from the tribes living on the Umpqua or Rogue Rivers, by whom they were gathered for food. (See *Garden and Forest*, x. 39.)

[1] "In most Pine trees there is a sameness of expression which to most people is apt to become monotonous; for the typical spiry form, however beautiful, affords but little scope for appreciable individual character. The Sugar Pine is as free from conventionalities of form and motion as any oak. No two are alike, even to the most inattentive observer; and, notwithstanding they are ever tossing out their immense arms in what might seem most extravagant gestures, there is a majesty and repose about them that precludes all possibility of the grotesque, or even picturesque, in their general expression." (Muir, *The Mountains of California*, 158.)

[2] Aylmer Bourke Lambert (1761–1842), the only son of Edward Lambert of Boynton House, near Haytesbury in Wiltshire, was born at Bath, and educated at St. Mary's Hall at Oxford. A collector from boyhood, he formed a museum before he went to school; and after leaving college he devoted himself to the study of botany, using his abundant means in forming a large herbarium and botanical library, which for many years were under the care of Mr. David Don, and in encouraging science. In 1797 Lambert published an illustrated description of the genus Cinchona, and in 1803 the first volume of his sumptuous description of the genus Pinus, a large folio with beautifully executed colored plates by which his name is best remembered; the second volume, prepared by David Don, appeared in 1824. A second edition of this work was published in 1828; and in 1837 the first edition of a third volume appeared, several of the plates representing the conifers discovered by Douglas in western America; this was also written by Don. An octavo edition of the first two volumes was published in 1832. Lambert was one of the founders in 1788 of the Linnæan Society, which he served as vice-president from 1796 until his death, and contributed many papers on botany and zoölogy to its Proceedings.

A genus of Australian shrubs bears the name of Lambert, and it has also been commemorated by Martius in *Aylmeria*, a genus of the Portulaca family, now referred to Polycarpæa.

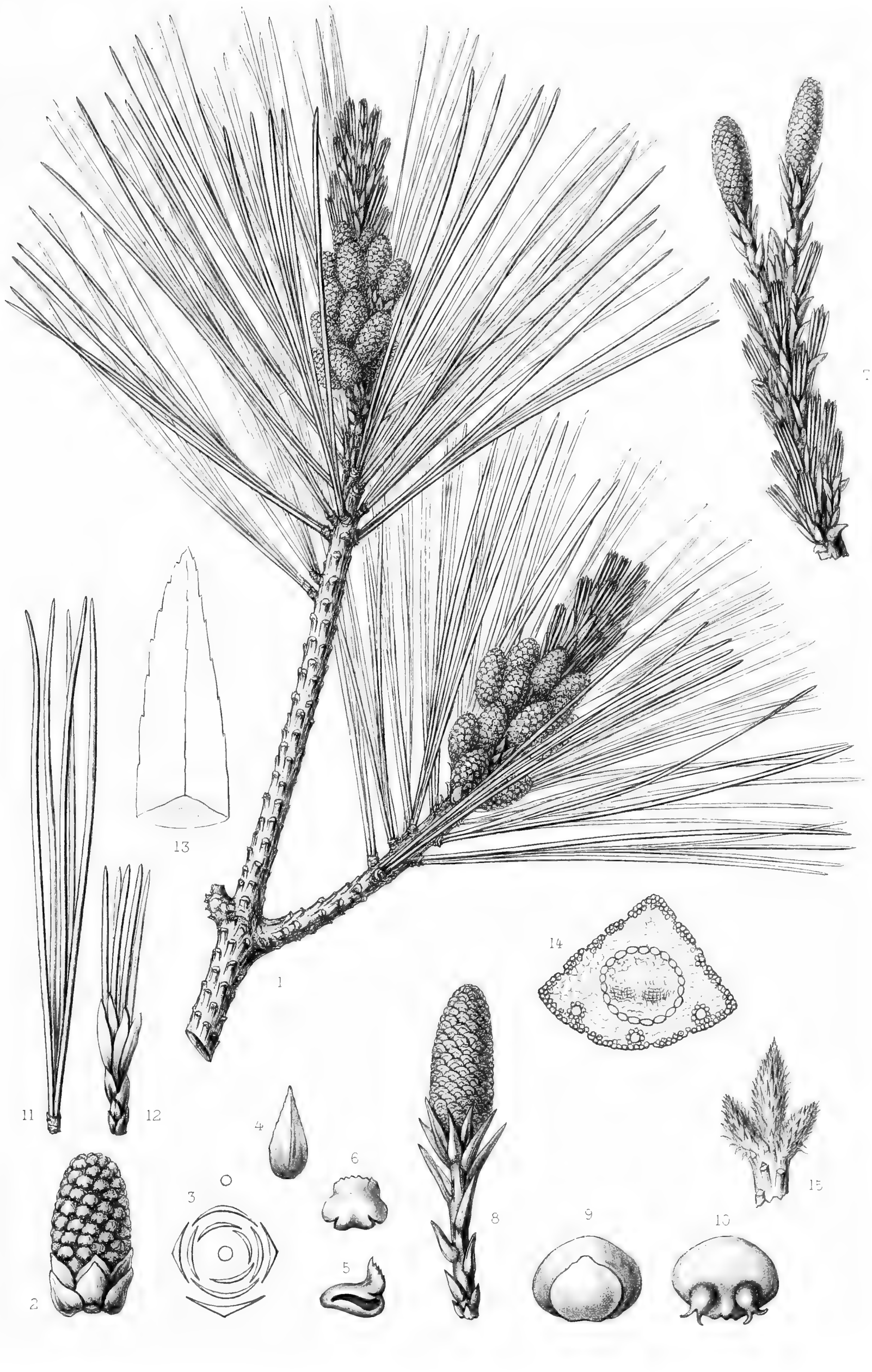
EXPLANATION OF THE PLATES.

Plate DXLII. Pinus Lambertiana.

1. A branch with staminate flowers, natural size.
2. A staminate flower, enlarged.
3. Diagram of the involucre of the staminate flower.
4. Bract of a staminate flower, enlarged.
5. An anther, side view, enlarged.
6. An anther, front view, enlarged.
7. Tip of a branch with pistillate flowers, natural size.
8. A pistillate flower, enlarged.
9. A scale of a pistillate flower, lower side, with its bract, enlarged.
10. A scale of a pistillate flower, upper side, with its ovules, enlarged.
11. A cluster of leaves, natural size.
12. A cluster of young leaves with its sheath, natural size.
13. Tip of a leaf, enlarged.
14. Cross section of a leaf, magnified fifteen diameters.
15. Winter branch-buds, natural size.

Plate DXLIII. Pinus Lambertiana.

1. A cone, natural size.
2. A cone-scale, upper side, with its seeds, natural size.
3. A seed with its wing, natural size.
4. Vertical section of a seed, enlarged.
5. An embryo, enlarged.



C.E.Faxon del. Rapine sc.

PINUS LAMBERTIANA, Dougl.

A.Riocreux direx.t Imp J.Taneur, Paris.

C.E.Faxon del.

Migneaux sc.

PINUS LAMBERTIANA, Dougl.

A Riocreux direx.t

Imp. J.Taneur, Paris

PINUS STROBIFORMIS.

White Pine.

LEAVES in 5-leaved clusters, slender, from $3\frac{1}{2}$ to 4 inches in length. Cones from 5 to 9 inches long, their scales thin, reflexed.

Pinus strobiformis, Engelmann, *Wislizenus Memoir of a Tour to Northern Mexico* (*Senate Doc.* 1848), Bot. Appx. 102. — Carrière, *Rev. Hort.* 1854, 228; *Fl. des Serres*, ix. 201; *Traité Conif.* 309. — Gordon, *Pinetum*, 238. — Henkel & Hochstetter, *Syn. Nadelh.* 116. — Pringle, *Garden and Forest*, i. 430. — Sargent, *Garden and Forest*, ii. 496.

Pinus Ayacahuite, Parlatore, *De Candolle Prodr.* xvi. pt. ii. 406 (in part) (not Schlechtendal) (1868). — Hemsley, *Bot. Biol. Am. Cent.* iii. 186 (in part).

Pinus flexilis, γ **reflexa**, Engelmann, *Rothrock Wheeler's Rep.* vi. 258 (1878).

Pinus reflexa, Engelmann, *Bot. Gazette*, vii. 4 (1882); *Gard. Chron.* n. ser. xvii. 260. — Sargent, *Forest Trees N. Am. 10th Census U. S.* ix. 189 (excl. hab. New Mexico). — Beissner, *Handb. Nadelh.* 275.

A tree, from eighty to one hundred feet in height, with a trunk rarely more than two feet in diameter, and short slender often somewhat pendulous branches forming a narrow pyramidal head. The bark of the trunk is from an inch to an inch and a half in thickness, and is irregularly divided by deep connected fissures into narrow rounded ridges covered by small loose reddish brown scales. The branchlets are slender, and when they first appear are coated with short close rufous pubescence; during their first winter they are light orange-brown and slightly puberulous, and in their third year are purplish and sometimes coated with a glaucous bloom. The winter branch-buds are ovate, acute, and about a third of an inch long, and are covered by ovate-lanceolate long-pointed thin pale chestnut-brown scales scarious and erose on the margins. The leaves are borne in clusters of five, and during the winter are inclosed in minute ovate compressed light green buds. The bud-scales lengthen with the young leaves, and, increasing in length from without inward, are when fully grown oblong, acute at the apex, thin, lustrous, and pale chestnut-brown, forming a rather close deciduous sheath from three quarters of an inch to nearly an inch in length. The leaves are slender, rigid, from three and a half to four inches long, sharply serrulate with minute remote teeth, especially toward the apex, or often nearly entire, and pale green; they are marked on the ventral faces with three or four rows of stomata, and contain a large fibro-vascular bundle and two dorsal resin ducts;[1] they begin to fall during their third season, and have usually disappeared before the end of their fourth year. The flowers open in Arizona at the very end of May. The staminate flowers are oval and a third of an inch in length, with anthers terminating in erect erose crests, and are surrounded by eight bracts. The pistillate flowers are subterminal and half an inch in length, with dark reddish purple slightly reflexed scales, and are raised on slender peduncles from one half to three quarters of an inch long, and clothed with ovate-lanceolate light chestnut-brown bracts conspicuously keeled on the back and thin and erose on the margins. At the end of their first season the young cones are erect on stout mostly naked peduncles from three quarters of an inch to an inch and a half in length, and are from an inch to an inch and a quarter long, half an inch broad, and light red-brown; they grow rapidly the following spring, usually remaining erect until after the appearance of the flowers, and at maturity are pendulous, from five to nine inches in length, about an inch and a half in breadth, and light green, with thin smooth scales about an inch and a quarter long, often nearly an inch wide at the base of the exposed portion, and narrowed and rounded at the much reflexed apex, which is tipped with a small rounded slightly thickened umbo; after the scales open their upper parts turn light brown slightly tinged with

[1] Coulter & Rose, *Bot. Gazette*, xi. 261.

red and their bases dark dull red. The seeds are broadly ovate, slightly compressed, half an inch long and about a third of an inch wide, with a thin dark red-brown coat produced into a narrow margin, and are furnished with thin dark rounded wings about an eighth of an inch in width.

Pinus strobiformis is scattered over the rocky ridges and the sides of the cañons of the Santa Catalina, Santa Rita, and Chiricahua Mountains of southern Arizona, and of the Sierra Madre of Chihuahua, at elevations of from six to eight thousand feet above the level of the sea, never forming groves and usually growing singly along the lower margin of the forests of *Pinus Arizonica*.

The wood of *Pinus strobiformis* is hard, although light, not strong, and close-grained; it is pale red, with thin nearly white sapwood, and contains thin inconspicuous bands of small summer cells, large resin passages, and numerous obscure medullary rays.[1] The specific gravity of the absolutely dry wood is 0.4877, a cubic foot weighing 30.39 pounds. The rarity of this tree and the inaccessibility of the places where it grows in the United States prevent the use of its wood, which is as valuable as that of the other western White Pines.

Pinus strobiformis was discovered by Dr. F. A. Wislizenus[2] in Chihuahua in October, 1846, and was first found in the territory of the United States by Dr. J. T. Rothrock[3] in 1874 on the Santa Rita Mountains of Arizona.

[1] *Pinus strobiformis*, considering the dryness of the region it inhabits, appears to grow with comparative rapidity. The specimen from the Santa Rita Mountains in the Jesup Collection of North American Woods in the American Museum of Natural History, New York, is thirty-one inches in diameter inside the bark, and is only one hundred and seventy-nine years old, with an inch and five eighths of sapwood showing forty-seven layers of annual growth.

[2] See vi. 94.

[3] See viii. 92.

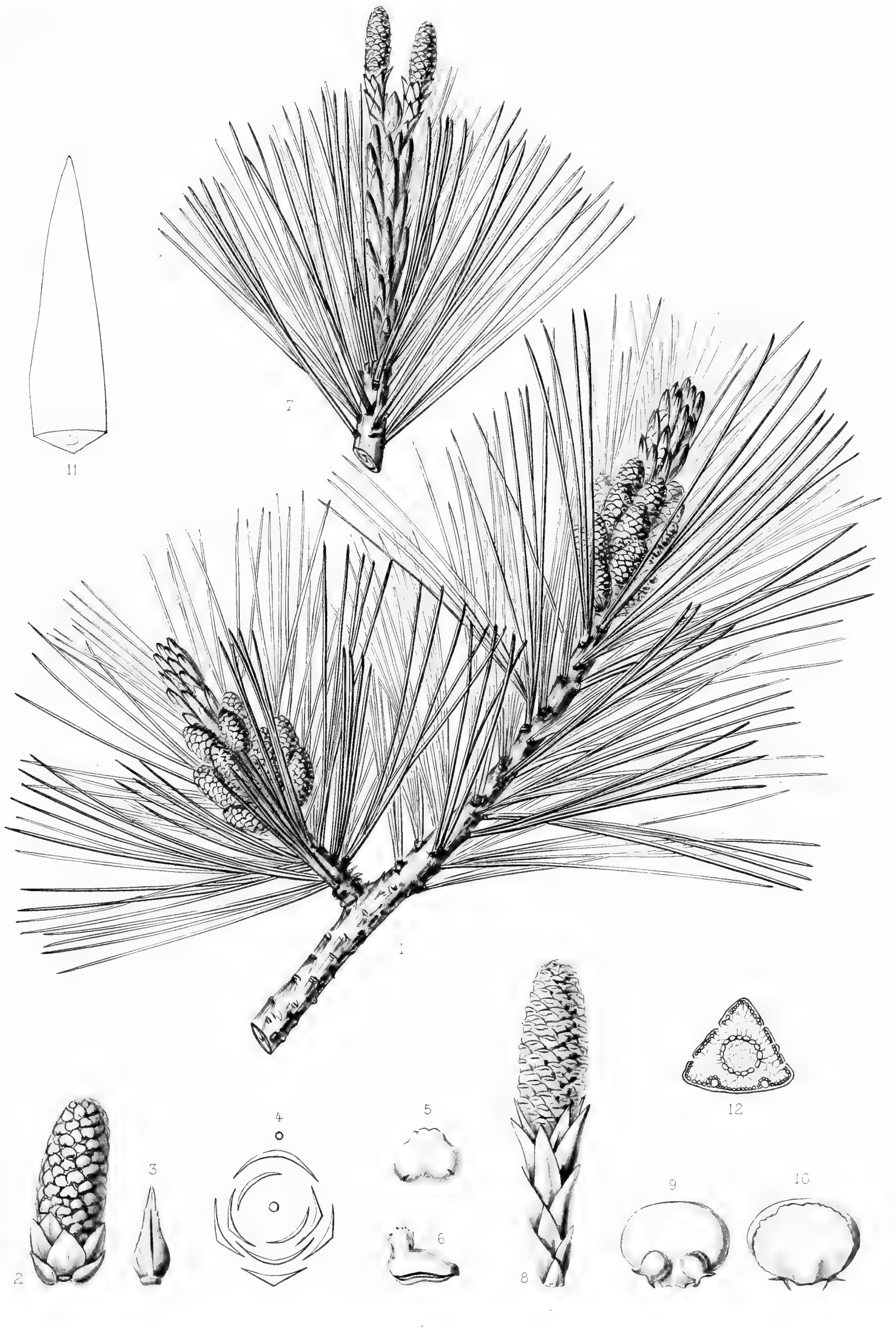
EXPLANATION OF THE PLATES.

PLATE DXLIV. PINUS STROBIFORMIS.

1. A branch with staminate flowers, natural size.
2. A staminate flower, enlarged.
3. Bract of a staminate flower, enlarged.
4. Diagram of the involucre of the staminate flower.
5. An anther, front view, enlarged.
6. An anther, side view, enlarged.
7. A branch with pistillate flowers, natural size.
8. A pistillate flower with its peduncle, enlarged.
9. A scale of a pistillate flower, upper side, with its ovules, enlarged.
10. A scale of a pistillate flower, lower side, with its bract, enlarged.
11. Tip of a leaf, enlarged.
12. Cross section of a leaf, magnified fifteen diameters.

PLATE DXLV. PINUS STROBIFORMIS.

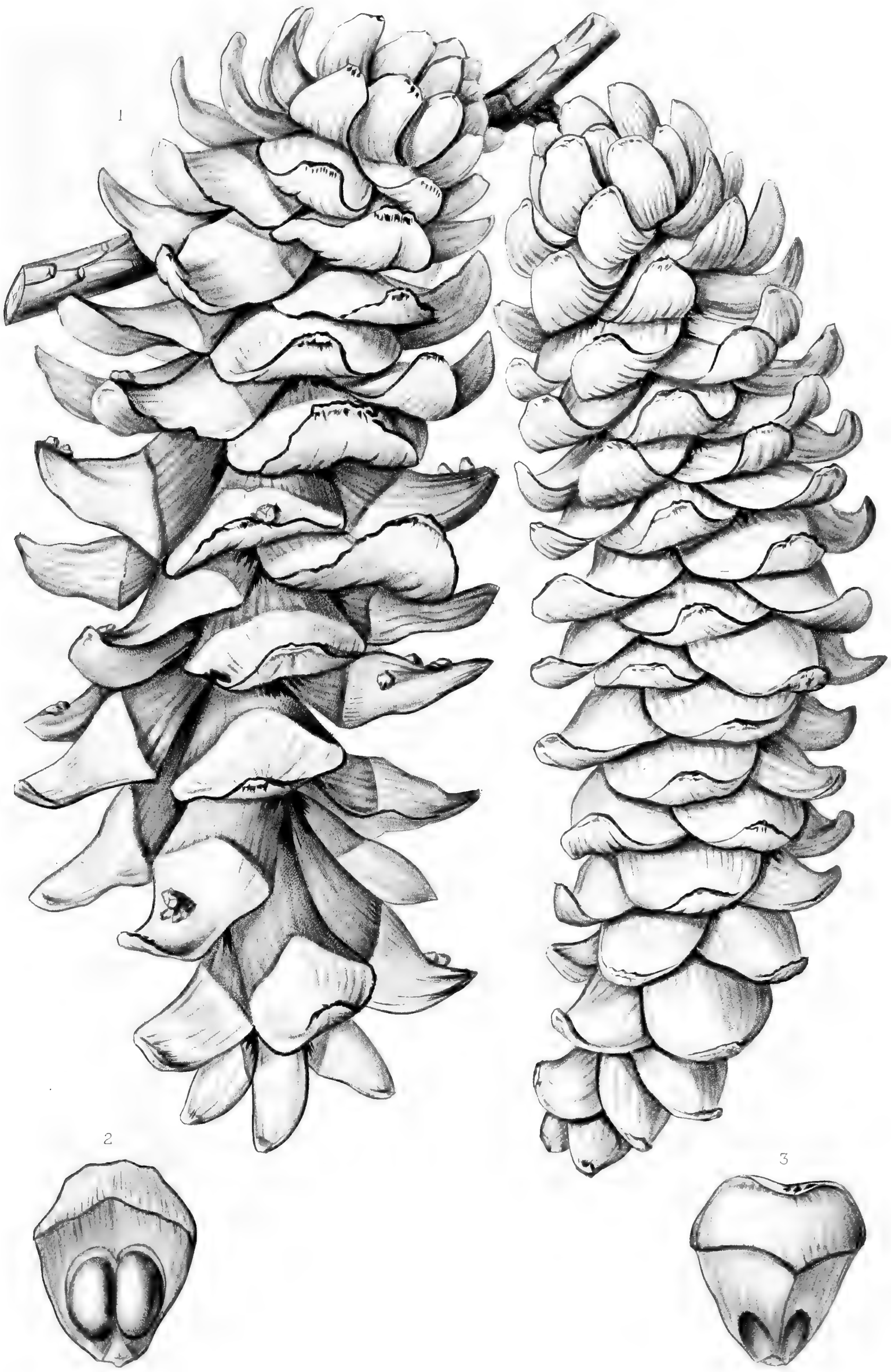
1. A portion of a fruiting branch, natural size.
2. A cone-scale, upper side, with its seeds, natural size.
3. A cone-scale, lower side, natural size.



C.E.Faxon del. *Em. Himely sc.*

PINUS STROBIFORMIS, Engelm.

A. Riocreux direx.t *Imp. J. Taneur, Paris*



2

3

C.E.Faxon del.

Em.Himely sc.

PINUS STROBIFORMIS, Engelm.

A.Riocreux direx.t

Imp. J.Taneur, Paris.

PINUS FLEXILIS.

White Pine.

LEAVES in 5-leaved clusters, thick, rigid, from $1\frac{1}{2}$ to 3 inches in length. Cones from 3 to 10 inches long, their scales rounded or pointed at the apex.

Pinus flexilis, James, *Long's Exped.* ii. 34 (1823). — Torrey, *Ann. Lyc. N. Y.* ii. 249; *Pacific R. R. Rep.* iv. pt. v. 141. — Engelmann, *Wislizenus Memoir of a Tour to Northern Mexico* (*Senate Doc.* 1848), Bot. Appx. 102; *Am. Jour. Sci.* ser. 2, xxxiv. 331; *Linnæa*, xxxiii. 388; *Trans. St. Louis Acad.* ii. 208; *Rothrock Wheeler's Rep.* vi. 257; *Brewer & Watson Bot. Cal.* ii. 124. — Nuttall, *Sylva*, iii. 107, t. 112. — Lindley & Gordon, *Jour. Hort. Soc. Lond.* v. 220. — Carrière, *Rev. Hort.* 1854, 228; *Fl. des Serres*, ix. 201; *Traité Conif.* 310. — J. M. Bigelow, *Pacific R. R. Rep.* iv. pt. v. 6, 20. — Gordon, *Pinetum*, 224. — Courtin, *Fam. Conif.* 72. — Parry, *Trans. St. Louis Acad.* ii. 121. — Henkel & Hochstetter, *Syn. Nadelh.* 126. — (Nelson) Senilis, *Pinaceæ*, 112. — Bolander, *Proc. Cal. Acad.* iii. 318. — Hoopes, *Evergreens*, 131, f. 18. — Sénéclauze, *Conif.* 112. — Parlatore, *De Candolle Prodr.* xvi. pt. ii. 403 (in part). — Watson, *King's Rep.* v. p. xxviii. 332. — Rothrock, *Pl. Wheeler*, 27, 50; *Wheeler's Rep.* vi. 9. — Porter & Coulter, *Fl. Colorado; Hayden Surv. Misc. Pub.* No. 4, 130. — A. Murray, *Gard. Chron.* n. ser. iii. 106; iv. 356 (in part), f. 75. — Hemsley, *Bot. Biol. Am. Cent.* iii. 187. — Lawson, *Pinetum Brit.* i. 33, f. 1. — Sargent, *Forest Trees N. Am. 10th Census U. S.* ix. 188. — Lauche, *Deutsche Dendr.* ed. 2, 113. — Coulter, *Man. Rocky Mt. Bot.* 431. — Tweedy, *Garden and Forest*, i. 130 (*Forests of the Yellowstone National Park*). — Lemmon, *Rep. California State Board Forestry*, ii. 70, 84 (*Pines of the Pacific Slope*); *West-American Cone-Bearers*, 23. — Steele, *Proc. Am. Pharm. Assoc.* 1889, 233 (*The Pines of California*). — Mayr, *Wald. Nordam.* 348, t. 7, f. — Beissner, *Handb. Nadelh.* 273. — Masters, *Jour. R. Hort. Soc.* xiv. 229. — Hansen, *Jour. R. Hort. Soc.* xiv. 360 (*Pinetum Danicum*). — Coville, *Contrib. U. S. Nat. Herb.* iv. 221 (*Bot. Death Valley Exped.*). — Koehne, *Deutsche Dendr.* 31.

Pinus Lambertiana, β ?, Hooker, *Fl. Bor.-Am.* ii. 161 (1839).

Pinus Lambertiana, ? B **brevifolia**, Endlicher, *Syn. Conif.* 150 (1847). — Lindley & Gordon, *Jour. Hort. Soc. Lond.* v. 215. — Carrière, *Traité Conif.* ed. 2, 404.

Pinus flexilis, var. α **serrulata**, Engelmann, *Rothrock Wheeler's Rep.* vi. 258 (1878).

Pinus flexilis, β **macrocarpa**, Engelmann, *Rothrock Wheeler's Rep.* vi. 258 (1878). — Coville, *Contrib. U. S. Nat. Herb.* iv. 221 (*Bot. Death Valley Exped.*). — Lemmon, *West-American Cone-Bearers*, 23.

? **Pinus reflexa**, Rusby, *Bull. Torrey Bot. Club*, ix. 80 (1882).

Pinus flexilis megalocarpa, Sudworth, *Bull.* No. 14, *Div. Forestry U. S. Dept. Agric.* 16 (1897).

A tree, usually forty or fifty feet in height, with a short massive trunk from two to four or rarely five feet in diameter, but occasionally seventy or eighty feet high, and stout long-persisting branches; or at high elevations on the mountain ranges of central Nevada reduced to a spreading shrub with stems only two or three feet tall. During its early years the short stout flexible branches stand out from the stem at right angles in regular whorls, forming a narrow open pyramid; but at the end of from fifty to one hundred years some of the lower branches begin to grow more rapidly than the others, pushing out in graceful upward curves, while several of the stoutest of the upper branches ascend, and thus a low round-topped broad-based head is formed.[1] On young stems and branches the bark is thin, smooth, and light gray or silvery white; on older trunks it breaks into small thin dark brown plates tinged with red and covered by small thin scales; and on large trunks it becomes from one to two inches in thickness and dark brown or nearly black, and divides by deep fissures into broad ridges broken into nearly square plates, which are covered by small closely appressed scales. The branchlets are stout and very tough, and when they first appear are light orange-green and clothed with soft fine pubescence; usually they soon become glabrous, and during their first winter they are light orange-brown or pale gray, gradually growing a darker orange-color or sometimes brown tinged with purple. The winter branch-buds are broadly ovate, and narrowed into slender points, and are covered by

[1] *Garden and Forest*, x. 162, f. 19.

ovate-lanceolate loosely imbricated light chestnut-brown scales scarious on the margins, the terminal bud being about half an inch long and a quarter of an inch broad and nearly twice as large as the lateral buds. The leaves are borne in five-leaved clusters, and during the winter are inclosed in minute compressed dark green buds covered with pale scurfy pubescence. The bud-scales when fully grown are thin, white and lustrous, or pale chestnut-brown, and form a close narrow sheath about three quarters of an inch long, and early deciduous. The leaves are stout, rigid, sharp-pointed with callous tips, entire, or rarely sparingly serrate toward the apex, dark green, and usually about two inches long, but vary from an inch and a half to three inches in length; they are marked with from one to four rows of ventral stomata, and contain a single fibro-vascular bundle and two dorsal and occasionally also one ventral resin duct surrounded by thin-walled strengthening cells;[1] they form dense tufts at the ends of the branches, and mostly fall during their fifth and sixth years. The staminate flowers, which are borne in short spikes, are oval and about half an inch long, with reddish anthers tipped with short spur-like crests, and are surrounded by eight or nine involucral bracts. The pistillate flowers are subterminal, clustered, about half an inch long, bright red-purple, and nearly sessile or short-stalked, their thick peduncles being covered with ovate acute persistent chestnut-brown bracts scarious on the margins and from one third to nearly one half an inch in length. In the autumn the young cones are erect, from three quarters of an inch to an inch long, about half an inch broad, and light reddish brown; they become horizontal, and grow rapidly during the following spring, and when the flowers open, which is late in June, or at the north early in July, they have attained about two thirds of their full size; and when fully grown in September they are oval or subcylindrical, horizontal and subsessile, or slightly declining on stout peduncles sometimes half an inch in length, light green, from three to ten inches long[2] and about an inch and a half wide, with thick scales rounded at the broad or somewhat narrowed apex, which is occasionally slightly reflexed, and is tipped with a thickened dark umbo, the lower sterile scales being narrow and strongly reflexed; the cones ripen and shed their seeds in September; the exposed portions of the scales then turn light brown, and the others dull light red, most of the cones falling from the branches late in the same autumn. The seeds are oval, compressed, and from one third to one half of an inch in length, and are covered by a dark red-brown coat mottled with black, and produced into a narrow margin; their wings are thin, dark reddish brown, and about one twelfth of an inch wide, and generally remain attached to the scales when the seeds fall; the cotyledons vary from six to nine in number.

The Rocky Mountain White Pine is distributed along the eastern base of the continental divide from Bow River in Alberta, where it grows on the river cliffs from near Calgary to Morleyville,[3] southward to western Texas, where it occurs on the Guadalupe and Limpio Mountains;[4] it ranges westward, usually at elevations of from five to ten thousand feet above the sea-level, over the mountains of Wyoming, Montana, Colorado, Utah, Nevada, and southwestern California, where it has been found on the Inyo and Panamint Mountains growing with *Pinus aristata*,[5] to the eastern slopes of the Sierra Nevada Mountains, where it is rare from Mono Pass east of the Yosemite Valley at elevations of from eight to nine thousand feet above the sea southward to Kearsarge Pass, crossing the Sierras to the south side of the cañon of the south fork of King's River, where it occurs at heights of from ten thousand five hundred to nearly twelve thousand feet above the sea;[6] it spreads over the mountain

[1] Coulter & Rose, *Bot. Gazette*, xi. 261.

[2] The longest cones are produced by trees growing on the San Francisco Peaks of northern Arizona at elevations of about eight thousand feet above the sea-level and on the mountains of southern Arizona (the var. *macrocarpa* of Engelmann and the var. *megalocarpa* of Sudworth). The same trees, however, bear cones varying from four to ten inches in length (see plate dxlvii.), and although the leaves on this form are slightly more slender and occasionally somewhat serrulate toward the apex, it can hardly be considered a botanical variety, as *Pinus flexilis*, in the northern Rocky Mountains, varies greatly in the size of its cones and in the thickness of its leaves. It is probably the large-coned southern form which is most common on the mountains of eastern Arizona and of New Mexico, and which has sometimes been referred to *Pinus strobiformis*.

[3] Macoun, *Cat. Can. Pl.* 465.

[4] Havard, *Proc. U. S. Nat. Mus.* viii. 503.

[5] Merriam, *North American Fauna*, No. 7, 340 (*Death Valley Exped.* ii.).

[6] *Teste* John Muir.

ranges of New Mexico and northern Arizona, generally at elevations of from seven to eight thousand feet, and is scattered through the forests of the Huachuca and Chiricahua Mountains of southern Arizona. *Pinus flexilis* most frequently grows singly or in small groves among other conifers, but is the principal tree on the upper foothills of the eastern slope of the Rocky Mountains in Montana, where it remains low and round-topped, forming an open stunted forest; and on many of the ranges of central Nevada on slopes and benches from seven to ten thousand feet above the sea-level it makes extensive open forests, and is the most valuable timber-tree, giving the name of White Pine to several mountain ranges and districts,[1] and attaining its largest size on the mountains of northern New Mexico and Arizona.[2]

The wood of *Pinus flexilis* is light, soft, and close-grained; it is pale clear yellow, turning red on exposure to the air, with thin nearly white sapwood, and contains inconspicuous narrow bands of small summer cells, numerous large resin passages, and many prominent medullary rays. The specific gravity of the absolutely dry wood is 0.4358, a cubic foot weighing 27.16 pounds. In northern Montana, in central Nevada, Utah, and New Mexico, it is sometimes manufactured into lumber which is full of knots but is used in construction and for various domestic purposes.

Pinus flexilis was discovered in 1820 in Colorado near the base of Pike's Peak by Dr. Edwin James,[3] the naturalist and surgeon of Long's Expedition to the Rocky Mountains. It was probably introduced into cultivation by Dr. C. C. Parry,[4] who first visited Colorado in 1861, and gathered the seeds of several coniferous trees. In the eastern United States it has grown very slowly, and gives no promise of becoming a valuable garden ornament; but in Europe it is more vigorous, and one specimen, at least, has produced cones in England.[5]

[1] Sargent, *Am. Jour. Sci.* ser. 3, xvii. 420 (*The Forests of Central Nevada*).

[2] See Merriam, *North American Fauna*, No. 3, 121.

[3] See ii. 96.

[4] See vii. 130.

[5] During the autumn of 1896 a specimen of *Pinus flexilis* in the Royal Gardens at Kew produced cones (*The Garden*, li. 73). This tree is twenty-five feet high, with a trunk two feet nine inches in circumference at the base, and two feet in circumference at six feet above the surface of the ground.

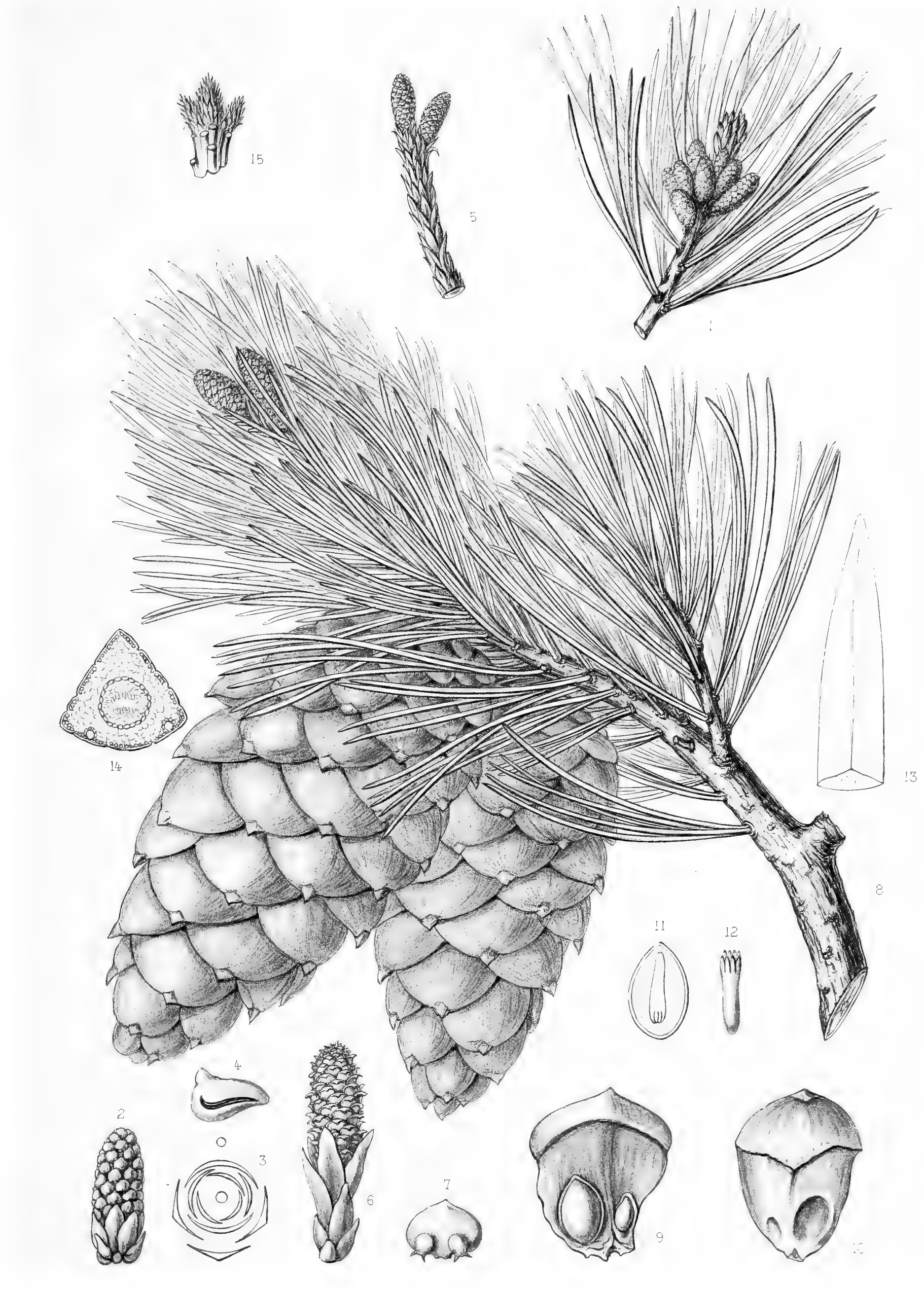
EXPLANATION OF THE PLATES.

PLATE DXLVI. PINUS FLEXILIS.

1. A branch with staminate flowers, natural size.
2. A staminate flower, enlarged.
3. Diagram of the involucre of the staminate flower.
4. An anther, side view, enlarged.
5. An end of a branch with pistillate flowers, natural size.
6. A pistillate flower, enlarged.
7. A scale of a pistillate flower, upper side, with its ovules, enlarged.
8. A fruiting branch, natural size.
9. A cone-scale, upper side, with its seeds, natural size.
10. A cone-scale, lower side, enlarged.
11. Vertical section of a seed, enlarged.
12. An embryo, enlarged.
13. Tip of a leaf, enlarged.
14. Cross section of a leaf, magnified fifteen diameters.
15. Winter branch-buds, natural size.

PLATE DXLVII. PINUS FLEXILIS. (From northern Arizona.)

1. A branch with young cones, natural size.
2. A cone, natural size.
3. A cone, natural size.
4. Tip of a leaf, enlarged.



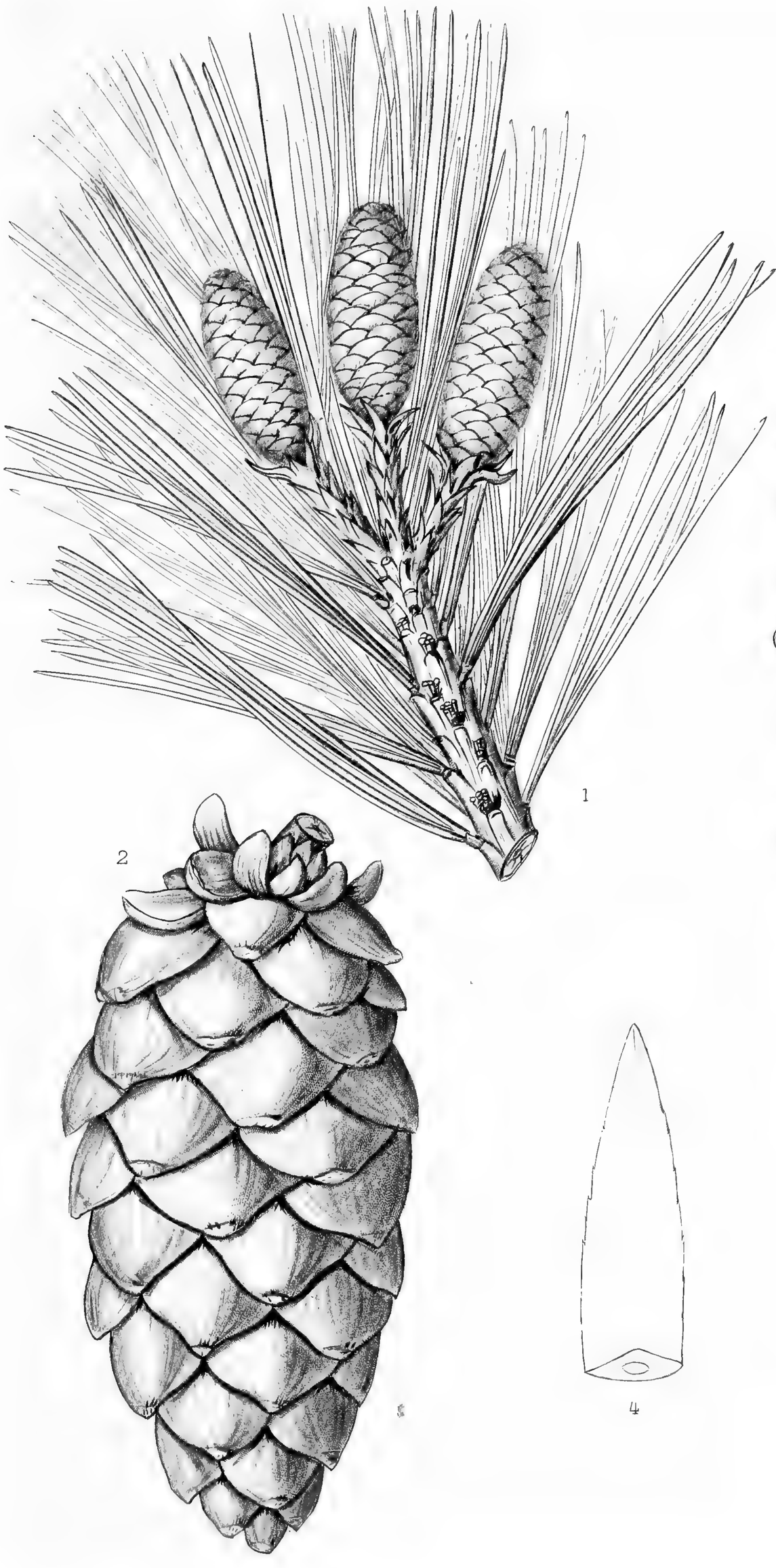
C.E. Faxon del.

Rapine sc.

PINUS FLEXILIS, James.

A. Riocreux direx.t

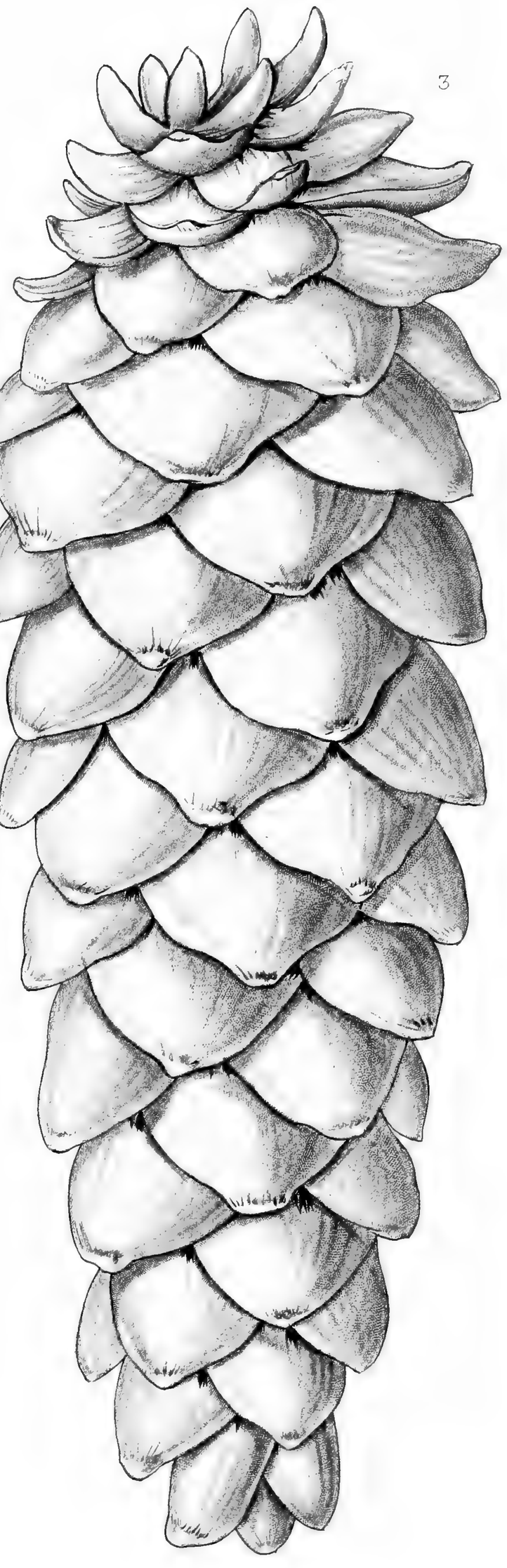
Imp. J. Taneur, Paris.



1

2

4



3

C.E. Faxon del. Em. Himely sc.

PINUS FLEXILIS, James.

A. Riocreux direx.t Imp. J. Taneur, Paris.

PINUS ALBICAULIS.

White Pine.

LEAVES in 5-leaved clusters, thick, rigid, from $1\frac{1}{2}$ to $2\frac{1}{2}$ inches in length. Cones oval or subglobose, from $1\frac{1}{2}$ to $3\frac{1}{4}$ inches long, their scales much thickened, dark purple, terminating in stout incurved nearly triangular tips.

Pinus albicaulis, Engelmann, *Trans. St. Louis Acad.* ii. 209 (1863); *Linnæa*, xxxiii. 390; *Bot. Gazette*, vii. 4. — Hall, *Bot. Gazette*, ii. 94. — Lawson, *Pinetum Brit.* i. 1, f. 1–4. — Sargent, *Forest Trees N. Am. 10th Census U. S.* ix. 189. — Hooker f. *Gard. Chron.* n. ser. xxiv. 9, f. 1, 2. — Lemmon, *Rep. California State Board Forestry*, ii. 70, 84, t. (*Pines of the Pacific Slope*); *West-American Cone-Bearers*, 24. — Steele, *Proc. Am. Pharm. Assoc.* 1889, 234 (*The Pines of California*). — Mayr, *Wald. Nordam.* 354, t. 7, f. — Beissner, *Handb. Nadelh.* 274. — Masters, *Jour. R. Hort. Soc.* xiv. 225. — Hansen, *Jour. R. Hort. Soc.* xiv. 345 (*Pinetum Danicum*). — Koehne, *Deutsche Dendr.* 31.

Pinus flexilis, A. Murray, *Rep. Oregon Exped.* 1, t. 2, f. 1 (not James) (1853). — Lyall, *Jour. Linn. Soc.* vii. 142. — Parlatore, *De Candolle Prodr.* xvi. pt. ii. 403 (in part).

Pinus cembroides, Newberry, *Pacific R. R. Rep.* vi. pt. iii. 44, 90, f. 15 (not Zuccarini) (1857).

Pinus Shasta, Carrière, *Traité Conif.* ed. 2, 390 (1867).

Pinus flexilis, var. **albicaulis**, Engelmann, *Brewer & Watson Bot. Cal.* ii. 124 (1880). — Coulter, *Man. Rocky Mt. Bot.* 432.

A tree, twenty or thirty or rarely sixty feet in height, with a short or rarely elongated trunk from two to four feet in diameter, or often at high altitudes a low shrub with wide-spreading stems. During its early years the stout branches, which are so flexible that they may be tied into knots, are arranged in regular whorls and stand out from the stem at right angles, forming a narrow compact pyramid;[1] later, several of the specialized upper branches grow much more rapidly than the others or than those below them, and, turning upward, stand at acute angles with the stem, forming an open very irregular comparatively broad head. The bark at the base of old trunks is sometimes half an inch in thickness, although on the body of the stem, on young trees, and on the large branches it is usually not more than from one eighth to one quarter of an inch thick, and is broken by narrow fissures into thin light brown or creamy white plate-like scales which when they fall disclose the light reddish brown inner bark. The branchlets are stout, puberulous sometimes during two years, or glabrous before their first winter, dark reddish brown or rather bright orange-color, and after they shed their leaves much roughened by the prominent scars left by the falling of the bud-scales. The winter branch-buds are broadly ovate, acute, and covered by loosely imbricated pale chestnut-brown scales, the terminal bud being often half an inch long and from one third to nearly one half of an inch wide, and much larger than the lateral buds. The leaves are arranged in clusters of five, with deciduous pale chestnut-brown sheaths about half an inch in length, the inner bud-scales being oblong-obovate and rather prominently ribbed, and are borne in dense tufts at the ends of naked branches; they are slightly incurved, stout and rigid, with a thick-walled epidermis, and are marked with from one to three rows of dorsal stomata; they are dark green, acute, and entire on the margins, and usually about an inch and a half in length, although on trees in sheltered positions sometimes nearly three inches long, and contain a single fibro-vascular bundle and two dorsal and sometimes also a ventral resin passage surrounded by strengthening cells;[2] the leaves on some trees begin to fall in their fifth season and drop irregularly, many of them remaining on the branches for three years longer, while on other trees most of the leaves appear to persist until

[1] In exposed positions the branches sometimes lengthen only from one eighth to one quarter of an inch during the few weeks of the year when growth is possible; and on Mt. Shasta, California, Muir has found branches thirty-six years old and only an eighth of an inch in diameter.

[2] Coulter & Rose, *Bot. Gazette*, xi. 260.

the seventh or eighth year. The flowers open from the first to the middle of July, or as soon as the snow under which this tree is usually buried for many months of the year has melted sufficiently to expose its branches to the sun. The staminate flowers are borne in short spikes and are oval, with scarlet anthers tipped by spur-like crests, and surrounded by involucres of eight or nine bracts. The pistillate flowers are oblong, sessile, clustered, about one third of an inch thick, with bright scarlet scales, and are surrounded by oblong-lanceolate chestnut-brown bracts. The young cones grow but little during their first season, and in the winter are erect and hardly more than half an inch long; the following summer they become horizontal, and, increasing rapidly in size during a few weeks, are fully grown by the end of August, when they are oval or subglobose, horizontal, sessile, and from an inch and a half to three inches and a quarter long, with much thickened gradually pointed purple scales, the exposed portion being contracted on both sides to a sharp edge bearing a stout nearly triangular more or less incurved dark tip; they discharge their seeds early in the autumn and mostly fall before winter. The seeds are ovate, acute, subcylindrical or somewhat flattened on one side by pressure against the bracts of the scales above, from one third to nearly one half of an inch in length and about one third of an inch in diameter, and are covered with a dark chestnut-brown hard thick coat produced into a narrow marginal border; their wings are thin, chestnut-brown, and about one thirty-second of an inch wide, and remain attached to the scales when the seeds fall; the cotyledons vary from seven to nine in number.

Pinus albicaulis inhabits alpine slopes, growing on the most exposed ridges at elevations of between five thousand and nearly twelve thousand feet above the sea-level, and mingling in the northern Rocky Mountains below with *Pinus flexilis*, and above with *Abies lasiocarpa*, and farther west with the Mountain Hemlock and *Abies lasiocarpa*. It forms the timber line on many of the high mountains of northwestern America, where it is distributed from about latitude 53° north in the Rocky Mountains[1] and from the valley of the Iltasyouco River,[2] southward over all the high ranges of southern British Columbia, sometimes descending near the sea to altitudes of five thousand feet; in the United States it extends southward along the Rocky Mountains to the Yellowstone plateau in northwestern Wyoming, where it is common about the head-waters of the Gallatin, Madison, and Snake Rivers, often descending as low as seven thousand five hundred feet above the sea-level;[3] it occurs on the Blue Mountains of Washington and Oregon, and on the Powder River and Warner Ranges in eastern Oregon,[4] and spreads along the Cascade Mountains of Washington and Oregon, where it is usually found at elevations of about six thousand feet; in California it forms extensive groves along the timber line on Mt. Shasta at eight thousand feet above the sea-level, ranges along the Sierra Nevada, where it is not common, to the slopes of Mt. Whitney,[5] and reappears on the San Bernardino Mountains, finding here its most southerly home, and forming on Grayback the upper border of the forest at altitudes of between ten thousand five hundred and eleven thousand six hundred and twenty-five feet.[6]

The wood of *Pinus albicaulis* is light, soft, brittle, and close-grained. It is light brown, with thin nearly white sapwood, and contains thin bands of small summer cells, numerous inconspicuous resin passages, and obscure medullary rays. The specific gravity of the absolutely dry wood is 0.4165, a cubic foot weighing 25.96 pounds. The sweet seeds were gathered and eaten by the Indians, although Clark's Crow, which tears the cones to pieces before they are ripe in order to devour the seeds, left them only scanty harvests.[7]

[1] Macoun, *Cat. Can. Pl.* 465.

[2] G. M. Dawson, *Can. Nat.* II. ser. ix. 328.

[3] Tweedy, *Garden and Forest*, i. 130 (*Forests of the Yellowstone National Park*).

[4] In the summer of 1896 *Pinus albicaulis* was found on the highest peaks of the Warner Range east of Goose Lake by Dr. C. Hart Merriam.

[5] Coville, *Contrib. U. S. Nat. Herb.* iv. 221 (*Bot. Death Valley Exped.*).

[6] S. B. Parish, *Zoë*, iv. 350.

[7] Newberry, *Popular Science Monthly*, xxxii. 36 (*Food and Fibre Plants of the North American Indians*).

Pinus albicaulis was discovered on the 23d of September, 1851, on the mountains rising from the valley of the lower Fraser River,[1] by John Jeffrey,[2] who sent the seeds to Scotland, where a few plants were raised. It grows very slowly in cultivation and has little to recommend it as an ornament of the park or garden. On bleak mountain slopes, however, struggling bravely on the advance line of the forest against the hardships which cannot subdue it, *Pinus albicaulis* is one of the most picturesque and interesting coniferous trees of North America.

[1] "Pinus sp. no. 398. Found on the summit of a mountain near Fort Hope, Fraser's River. I could only find a few specimens of this tree on which there were few cones. The few that were, Corvus Columbianus had deprived them of nearly all their seeds. Leaves in fives, short and rigid; cones small, nearly round; bark smooth; tree 30 ft. by 1 foot diameter; growing on granite decayed. Lat. 50°; elevation 7,000 feet. Sept. 23d, 1851." (From an unpublished and undated letter of Jeffrey to Professor J. H. Balfour preserved in the herbarium of the Royal Gardens at Edinburgh.)

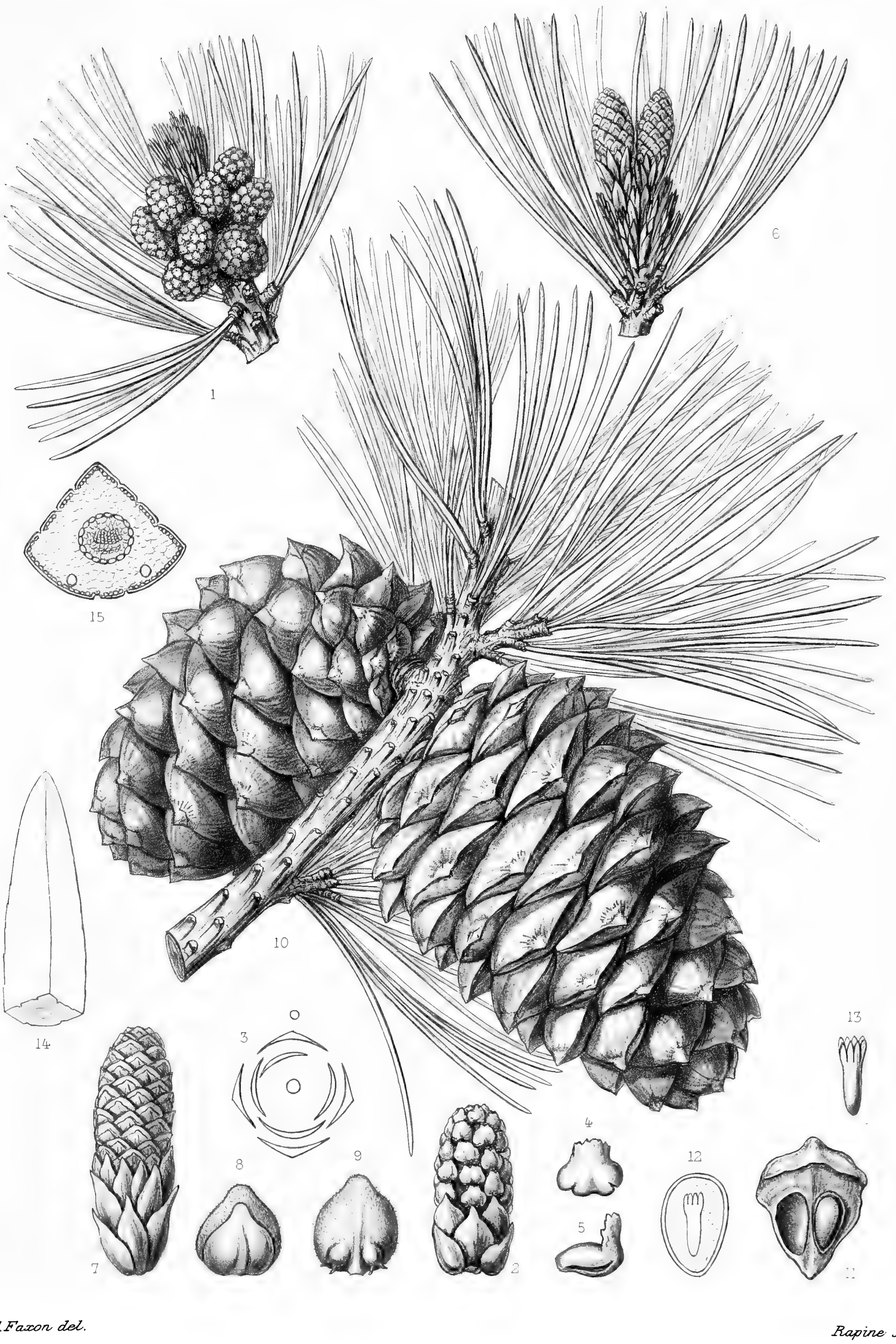
[2] The birthplace of John Jeffrey and the dates of his birth and death are unknown. On the 22d of November, 1849, a meeting of gentlemen interested in the promotion of arboriculture and horticulture in Scotland was held at the Botanic Garden in Edinburgh. At this meeting it was decided to send to western North America a botanist to collect the seeds of trees, shrubs, and other plants suitable for the decoration of gardens, in the regions traversed by David Douglas, and "to complete his researches and to extend them into those parts of the country not fully explored by him." A fund was raised to pay the expenses of this expedition, the subscribers organizing under the chairmanship of Professor J. H. Balfour, and designating themselves the Oregon Botanical Association. John Jeffrey, a young gardener, was selected by the association to carry out its work; and early in June, 1850, he sailed for Hudson Bay. On April 7, 1851, Jeffrey wrote to Professor Balfour, from Jaspar House on the head-waters of the Athabasca River in the Rocky Mountains, that he had left York Factory on the 20th of August of the previous year, and, traveling on foot, had reached Cumberland House, on the Saskatchewan, on the 6th of October and had remained there until January, 1851, when he proceeded up the Saskatchewan, reaching Jaspar House on the 21st of March. From Jaspar House Jeffrey crossed the Rocky Mountains by the Athabasca Pass, reached the Columbia River, and descended it to Fort Colville, a few miles above the mouth of Colville River, where he arrived about the 30th of May, 1851. Thence he traveled to the northwest to the Fraser River, which he descended to Vancouver Island, continuing to collect during the remainder of the season in southern British Columbia and about Mt. Baker in northern Washington, and probably exploring higher altitudes than any of his predecessors, as he discovered at this time such alpine trees as *Pinus albicaulis* and Patton's Spruce. The following year he went southward to Washington and Oregon as far as Mt. Shasta, and on Scott Mountain in northern California discovered *Pinus Balfouriana* and *Pinus Jeffreyi*. In 1853 Jeffrey continued to collect in southern Oregon and northern California, and in the autumn of that year reached San Francisco. The plants collected by him in 1853 were the last that Jeffrey sent to Edinburgh, and his connection with the association ceased at this time. Afterward he appears to have gone to San Diego, California, with the intention of crossing the Colorado Desert to Fort Yuma; and in attempting to penetrate the desert alone he probably perished of thirst, as nothing more was heard of him. (See Coville, *Proc. Biol. Soc. Washington*, xi. 57 [*The Itinerary of John Jeffrey, an early Botanical Explorer of western North America*].)

In one of the printed lists of plants collected by Jeffrey sent out by Mr. Andrew Murray, the secretary of the Oregon Botanical Association, to the subscribers, and, although without date, apparently issued in 1853, are first described *Abies concolor*, here called *Picea lasiocarpa* (not *Pinus lasiocarpa*, Hooker), *Pinus Balfouriana*, *Pinus Jeffreyi*, *Pinus Murrayana*, and *Pinus albicaulis*, here referred to *Pinus flexilis*. This now rare paper contains figures of *Pinus Jeffreyi*, *Pinus albicaulis*, *Pinus attenuata*, here called *Pinus tuberculata*, *Pinus Balfouriana*, *Pinus Murrayana*, *Abies concolor*, *Tsuga Pattonii*, and *Libocedrus decurrens*, here called *Thuja Craigana*.

EXPLANATION OF THE PLATE.

PLATE DXLVIII. PINUS ALBICAULIS.

1. An end of a branch with staminate flowers, natural size.
2. A staminate flower, enlarged.
3. Diagram of the involucre of the staminate flower.
4. An anther, front view, enlarged.
5. An anther, side view, enlarged.
6. An end of a branch with pistillate flowers, natural size.
7. A pistillate flower, enlarged.
8. A scale of a pistillate flower, under side, with its bract, enlarged.
9. A scale of a pistillate flower, upper side, with its ovules, enlarged.
10. A fruiting branch, natural size.
11. A cone-scale, upper side, natural size.
12. Vertical section of a seed, enlarged.
13. An embryo, enlarged.
14. Tip of a leaf, enlarged.
15. Cross section of a leaf, magnified fifteen diameters.



C.E.Faxon del. *Rapine sc.*

PINUS ALBICAULIS, Engelm.

A.Riocreux direx.t *Imp: J.Taneur, Paris.*

PINUS QUADRIFOLIA.

Nut Pine. Piñon.

LEAVES in 3 to 5-leaved clusters, stout, glaucous, $1\frac{1}{4}$ to $1\frac{3}{4}$ inches in length. Cones subglobose, $1\frac{1}{4}$ to 2 inches broad.

Pinus quadrifolia, Sudworth, *Bull.* No. 14, *Div. Forestry, U. S. Dept. Agric.* 17 (1897).

Pinus Llaveana, Torrey, *Bot. Mex. Bound. Surv.* 208, t. 53 (not Schlechtendal) (1859). — Bolander, *Proc. Cal. Acad.* iii. 318.

Pinus Parryana, Engelmann, *Am. Jour. Sci.* ser. 2, xxxiv. 332 (not Gordon) (1862); *Brewer & Watson Bot. Cal.* ii. 124. — Parlatore, *De Candolle Prodr.* xvi. pt. ii. 402. — Kellogg, *Forest Trees of California*, 49. — Sargent, *Forest Trees N. Am. 10th Census U. S.* ix. 189. — Lemmon, *Rep. California State Board Forestry*, ii. 72, 89, t. (*Pines of the Pacific Slope*); *West-American Cone-Bearers*, 28, t. 3. — Steele, *Proc. Am. Pharm. Assoc.* 1889, 234 (*The Pines of California*). — Mayr, *Wald. Nordam.* 277, t. 7, f. — Beissner, *Handb. Nadelh.* 255. — Masters, *Jour. R. Hort. Soc.* xiv. 236. — Hansen, *Jour. R. Hort. Soc.* xiv. 380 (*Pinetum Danicum*). — Koehne, *Deutsche Dendr.* 33. — S. B. Parish, *Zoë*, iv. 350.

A tree, from thirty to forty feet in height, with a trunk occasionally eighteen inches in diameter. During its first years the young plant, like all the Nut Pines, bears only primary leaves; these are linear-lanceolate, entire, strongly keeled, about an inch long, very glaucous, and marked with conspicuous bands of stomata; at the end of five or six years they are shorter and begin to bear in their axils the buds of leaf-clusters; as these develop, the primary leaves, which gradually become smaller and bract-like, wither and fall, and the plant assumes its adult appearance.[1] The stout spreading branches form a compact regular pyramid, the broad base often resting on the ground, and in old age a loose round-topped irregular head surmounting the short stem. The bark of the trunk is dark brown tinged with red, from one half to three quarters of an inch in thickness, and divided by shallow fissures into broad flat connected ridges covered by thick closely appressed plate-like scales. The branchlets are stout, and when they first appear are coated with short soft pubescence, and are made conspicuous by the large broadly oval light brown scales of the branch-buds, which cover them before the leaf-buds begin to lengthen and do not disappear until the end of their second season, when the branchlets become light orange-brown, growing darker and more or less tinged with red in their third year. In June, after the appearance of the flowers, the scales of the leaf-buds lengthen with the young leaves, forming close narrow pale chestnut-brown sheaths about half an inch in length, the scales soon becoming reflexed and usually persisting at the base of the leaf-cluster until the following spring. The foliage leaves are borne in from three to five or usually in four-leaved clusters and are incurved, sharp-pointed with callous tips, entire, pale glaucous green, from an inch and a half to an inch and three quarters in length and often one eighth of an inch in width, the dorsal side being wider than either of the others; they contain a single fibro-vascular bundle and two large dorsal resin ducts surrounded by strengthening cells, and are marked on the ventral sides with from eight to ten rows of conspicuous stomata;[2] they fall irregularly and mostly during their third season, although many of them persist until their fourth year. The staminate flowers, which are produced in elongated spikes, are oval and nearly a quarter of an inch long, their anthers terminating in laciniated crests, and are surrounded by an involucre of four conspicuous bracts rather longer than the bud-scales. The pistillate flowers are subterminal, solitary or clustered, nearly sessile, subglobose, and from one eighth to one quarter of an inch in length, with broadly obovate scales gradually narrowed at the rounded apex into short broad points. The cones are subglobose and from an inch and a half to two inches broad, with

[1] *Gard. Chron.* ser. 3, xxi. f. 92.

[2] Coulter & Rose, *Bot. Gazette*, xi. 303.

concave scales rounded at the apex; their exposed portion is thickened, conspicuously keeled transversely, narrowed into a central elevated knob terminating in a truncate or concave umbo armed with a minute recurved tip, and bright chestnut-brown and lustrous, while the rest of the scale is dull red; a few only of the central scales are fertile; the others gradually decrease in size toward both ends of the cone, and those at its base, being much reflexed and remaining closed, form a broad flat base. The seeds are somewhat narrowed and compressed at the apex, full and rounded at the base, about five eighths of an inch long and one third of an inch wide, dark red-brown and more or less mottled, with a thin brittle shell and a sweet slightly resinous albumen; their wings are thin, pale chestnut-brown, about an eighth of an inch wide, and remain attached to the scales after the seeds fall; the cotyledons are usually eight in number.

Pinus quadrifolia forms open forests on the arid mesas and low mountain slopes of Lower California,[1] extending southward to the foothills of Mt. San Pedro Martir,[2] on which it is almost the only tree, and northward into California, where only a few specimens have been found.[3]

The wood of *Pinus quadrifolia* is light, soft, and close-grained; it is pale brown or yellow, with much lighter colored nearly white sapwood, and contains thin bands of small summer cells, many large conspicuous resin passages, and numerous obscure medullary rays. The specific gravity of the absolutely dry wood is 0.5675, a cubic foot weighing 35.37 pounds.[4] The seeds are eaten raw or are roasted, and form an important article of food for the Indians of Lower California.

Pinus quadrifolia was discovered in June, 1850, by Dr. C. C. Parry,[5] one of the botanists of the commission appointed to establish the boundary between the United States and Mexico, sixty miles southeast of San Diego, California, at an elevation of about two thousand feet above the sea-level. It is occasionally cultivated in the gardens of California.

[1] From near the boundary line of the United States an open forest of *Pinus quadrifolia* about thirty miles wide extends southward for nearly fifty miles, covering, at elevations varying from three thousand five hundred to seven thousand feet above the sea-level, the wide table-lands which here form the backbone of the peninsula. (See Orcutt, *Garden and Forest*, v. 183.)

[2] T. S. Brandegee, *Zoë*, iv. 201.

[3] *Pinus quadrifolia* was found by Mr. George R. Vasey in June, 1880, near Larkin Station, San Diego County, twenty miles southeast of Campo, not far from the Mexican boundary line; and Mr. Carl Purdy reports it from the neighborhood of Julian at the head of the San Diego River.

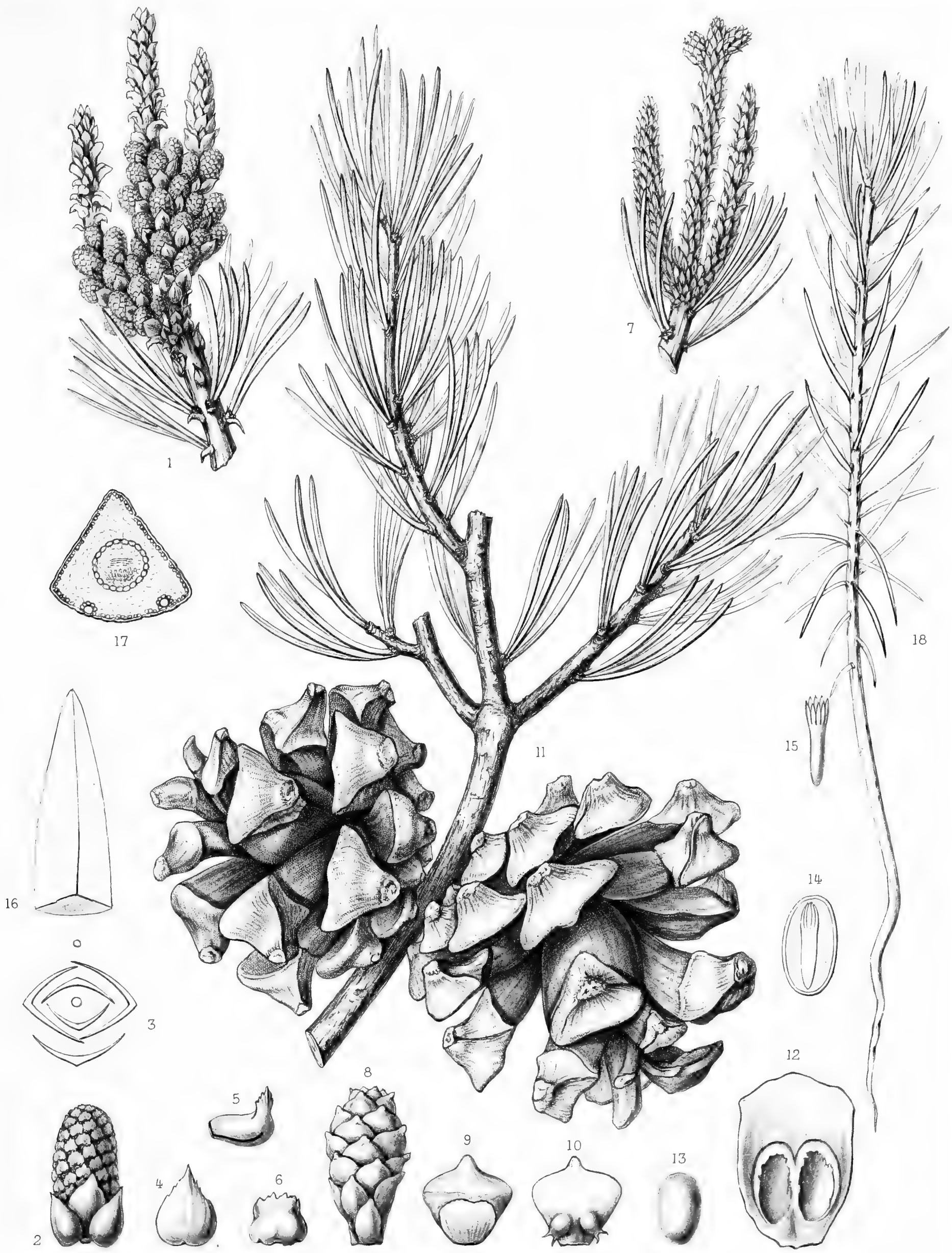
[4] *Pinus quadrifolia* probably grows very slowly. The log specimen in the Jesup Collection of North American Woods in the American Museum of Natural History, New York, is twelve and one half inches in diameter inside the bark and one hundred and sixty years old, the sapwood being an inch and a half in thickness and containing forty-eight layers.

[5] See vii. 130.

EXPLANATION OF THE PLATE.

PLATE DXLIX. PINUS QUADRIFOLIA.

1. A branch with staminate flowers, natural size.
2. A staminate flower, enlarged.
3. Diagram of the involucre of the staminate flower.
4. Bract of a staminate flower, enlarged.
5. An anther, side view, enlarged.
6. An anther, front view, enlarged.
7. A branch with pistillate flowers, natural size.
8. A pistillate flower, enlarged.
9. A scale of a pistillate flower, lower side, with its bract, enlarged.
10. A scale of a pistillate flower, upper side, with its ovules, enlarged.
11. A fruiting branch, natural size.
12. A cone-scale, upper side, natural size.
13. A seed, natural size.
14. Vertical section of a seed, enlarged.
15. An embryo, enlarged.
16. Tip of a leaf, enlarged.
17. Cross section of a leaf, magnified fifteen diameters.
18. A seedling plant, natural size.



C.E.Faxon del. *Rapine sc.*

PINUS QUADRIFOLIA, Sudw.

A.Riocreux direx.t *Imp. J. Taneur, Paris.*

PINUS CEMBROIDES.

Piñon. Nut Pine.

LEAVES in 2 or 3-leaved clusters, slender, from 1 to 2 inches in length. Cones from 1 to 2 inches broad.

Pinus cembroides, Zuccarini, *Abhand. Akad. Münch.* i. 392 (1832); *Flora*, 1832, ii. Beibl. 93. — Bentham, *Pl. Hartweg.* 58. — Link, *Linnæa*, xv. 511. — Endlicher, *Syn. Conif.* 182. — Lawson & Son, *List No. 10, Abietineæ*, 45. — Dietrich, *Syn.* v. 401. — Gordon, *Jour. Hort. Soc. Lond.* i. 236, f.; *Fl. des Serres*, iv. 324[b], f. 97. — *Pinetum*, ed. 2, 265. — Lindley & Gordon, *Jour. Hort. Soc. Lond.* v. 216. — Carrière, *Traité Conif.* 404. — Courtin, *Fam. Conif.* 92. — (Nelson) Senilis, *Pinaceæ*, 107. — Sénéclauze, *Conif.* 146. — Parlatore, *De Candolle Prodr.* xvi. pt. ii. 397. — Watson, *Proc. Am. Acad.* xviii. 158. — Hemsley, *Bot. Biol. Am. Cent.* iii. 186. — Sargent, *Forest Trees N. Am. 10th Census U. S.* ix. 190. — Masters, *Jour. R. Hort. Soc.* xiv. 227. — Hansen, *Jour. R. Hort. Soc.* xiv. 356 (*Pinetum Danicum*). — Lemmon, *West-American Cone-Bearers*, 28.

Pinus Llaveana, Schlechtendal, *Linnæa*, xii. 488 (1838). — Forbes, *Pinetum Woburn.* 49, t. 17. — Antoine, *Conif.* 36, t. 16, f. 1. — Spach, *Hist. Vég.* xi. 401. — Lindley & Gordon, *Jour. Hort. Soc. Lond.* v. 216. — Carrière, *Traité Conif.* 405. — Gordon, *Pinetum*, 199. — Henkel & Hochstetter, *Syn. Nadelh.* 64 (excl. syn. *Pinus edulis*). — Hoopes, *Evergreens*, 143.

Pinus osteosperma, Engelmann, *Wislizenus Memoir of a Tour to Northern Mexico* (*Senate Doc.* 1848), Bot. Appx. 89. — Lindley & Gordon, *Jour. Hort. Soc. Lond.* v. 216. — Carrière, *Fl. des Serres*, ix. 201; *Rev. Hort.* 1854, 227. — Mayr, *Wald. Nordam.* 241. — Beissner, *Handb. Nadelh.* 253. — Hansen, *Jour. R. Hort. Soc.* xiv. 380 (*Pinetum Danicum*).

A bushy tree, with a short stem rarely more than a foot in diameter and a broad round-topped head, usually from fifteen to twenty feet high, but in sheltered cañons on the mountains of Arizona[1] and in Lower California occasionally fifty or sixty feet in height. The bark of the trunk, which is about half an inch in thickness, is irregularly divided by remote shallow fissures and separates freely on the surface into numerous large thin light red-brown scales.[2] The branch-buds are ovate, gradually narrowed and acute at the apex, and about a quarter of an inch long, with bright chestnut-brown lustrous scales thin and scarious on the margins and contracted into long tips; these scales cover the lengthening closely imbricated leaf-buds in May or June, when the flowers expand, making the young branches at this time extremely conspicuous, and do not entirely disappear until the second or third season. The branchlets are slender, dark orange-colored, and covered with matted pale deciduous hairs when they first appear; during their first winter they are dark brown or orange-colored, and then, gradually growing darker, are at the end of five or six years sometimes nearly black and still much roughened by the scars left by the fallen bud-scales. The leaves are borne in clusters of two or of three, with thin close sheaths scarious on the margins, about a quarter of an inch long and mostly persistent for one or for two years; they are slender, usually much incurved, entire, acute with elongated callous tips, dark green, and from one to two inches in length; they are marked on each ventral surface with from four to six rows of stomata, and contain two dorsal resin ducts surrounded by strengthening cells, and a single fibro-vascular bundle;[3] they fall irregularly during the third and fourth year. The staminate flowers are produced in short compact clusters, and are oval, about a quarter of an inch long, with yellow crested anthers, and are surrounded by an involucre of four bracts. The pistillate flowers are lateral and erect on short stout peduncles covered by ovate acute

[1] *Teste* Dr. T. E. Wilcox, U. S. Army.

[2] The conspicuously scaly bark of *Pinus cembroides* readily distinguishes it from the other American Nut Pines, on which the bark is more or less deeply divided into connected ridges and separates slowly into small closely appressed scales.

[3] Coulter & Rose, *Bot. Gazette*, xi. 303.

light chestnut-brown bracts, and are oblong, acute, and about one eighth of an inch in length, with thick dark red scales. In the autumn the young cones are about half an inch in diameter and horizontal; the following spring they grow rapidly, and by the time the flowers open they are sometimes nearly an inch long and three quarters of an inch broad; when fully grown they are subglobose, from an inch to almost two inches in breadth, and short-stalked or subsessile; the exposed portions of their light red-brown concave scales are rounded or acute at the apex, and much thickened and quadrangular on the back, with prominent horizontal and less prominent longitudinal keels, the central knob terminating in a dark-colored concave umbo bearing on its margin a small dark brown nearly triangular much reflexed tip; only a few of the central scales, which are about three quarters of an inch broad, are fertile; the others decrease in size toward both ends of the cone, and those at its base are much reflexed and remain closed. The seeds are subcylindrical or slightly triangular, more or less compressed at the pointed apex, full and rounded at the base, from one half to three quarters of an inch long, about three eighths of an inch wide, nearly black on the lower side, and dark chestnut-brown on the upper, where they are pressed upon by the bracts and scales above them; the wings are light chestnut-brown, membranaceous, and about one thirty-second of an inch wide, and remain attached to the scales when the seeds fall; the cotyledons vary from nine to fifteen in number.

Pinus cembroides inhabits in southern Arizona the Santa Catalina, Rincon, Santa Rita, Huachuca, and Chiricahua[1] Mountains generally above elevations of six thousand five hundred feet, and covers their highest slopes and ridges, usually unmixed with other trees, and grows also on the Pinal, Superstition, Caliuro, and Gila Mountains near the centre of the territory.[2] It occurs in Lower California,[3] and spreads southward over the mountain ranges of northern Mexico, growing in the thin soil of the hottest and most arid slopes and ledges,[4] or in Nuevo Leon on the cooler slopes and summits of the foothills, often descending to within a few hundred feet of the level of the plain.[5]

The wood of *Pinus cembroides* is light, soft, and close-grained; it is pale clear yellow, with thin nearly white sapwood, and contains thin inconspicuous bands of small summer cells, occasional small conspicuous resin passages, and numerous obscure medullary rays. The specific gravity of the absolutely dry wood is 0.6512, a cubic foot weighing 40.58 pounds.[6]

The large oily seeds supply the inhabitants of northern Mexico with an important article of food, and are sold in large quantities in the markets of most Mexican towns.

Pinus cembroides was discovered on the high mountains near Sultepec in Mexico about 1830 by the Belgian naturalist Karwinsky;[7] it was first found in the United States by Mr. C. G. Pringle[8] on the Santa Catalina Mountains, Arizona, in June, 1882. It was introduced into European gardens by Karl Theodor Hartweg[9] in 1846, and is now occasionally cultivated in those of southern Europe and of northern Mexico.

[1] *Pinus cembroides* was collected on the Chiricahua Mountains in 1894 by Professor J. W. Toumey. (See *Garden and Forest*, viii. 22.)

[2] Toumey, *Garden and Forest*, x. 152.

[3] *Pinus cembroides* was found in 1890 by Mr. T. S. Brandegee on the flat top of the Sierra de Laguna in Lower California, where it sometimes grows to a height of fifty feet. (See *Garden and Forest*, iv. 352, f. 59.)

[4] Pringle, *Garden and Forest*, i. 430.

[5] Pringle, *l. c.* iii. 338.

[6] *Pinus cembroides* probably always grows slowly. The trunk in the Jesup Collection of North American Woods in the American Museum of Natural History, New York, is eight and three quarters inches in diameter inside the bark and one hundred and forty-six years old, with sapwood five eighths of an inch in thickness containing twenty-two layers of annual growth.

[7] See i. 94.

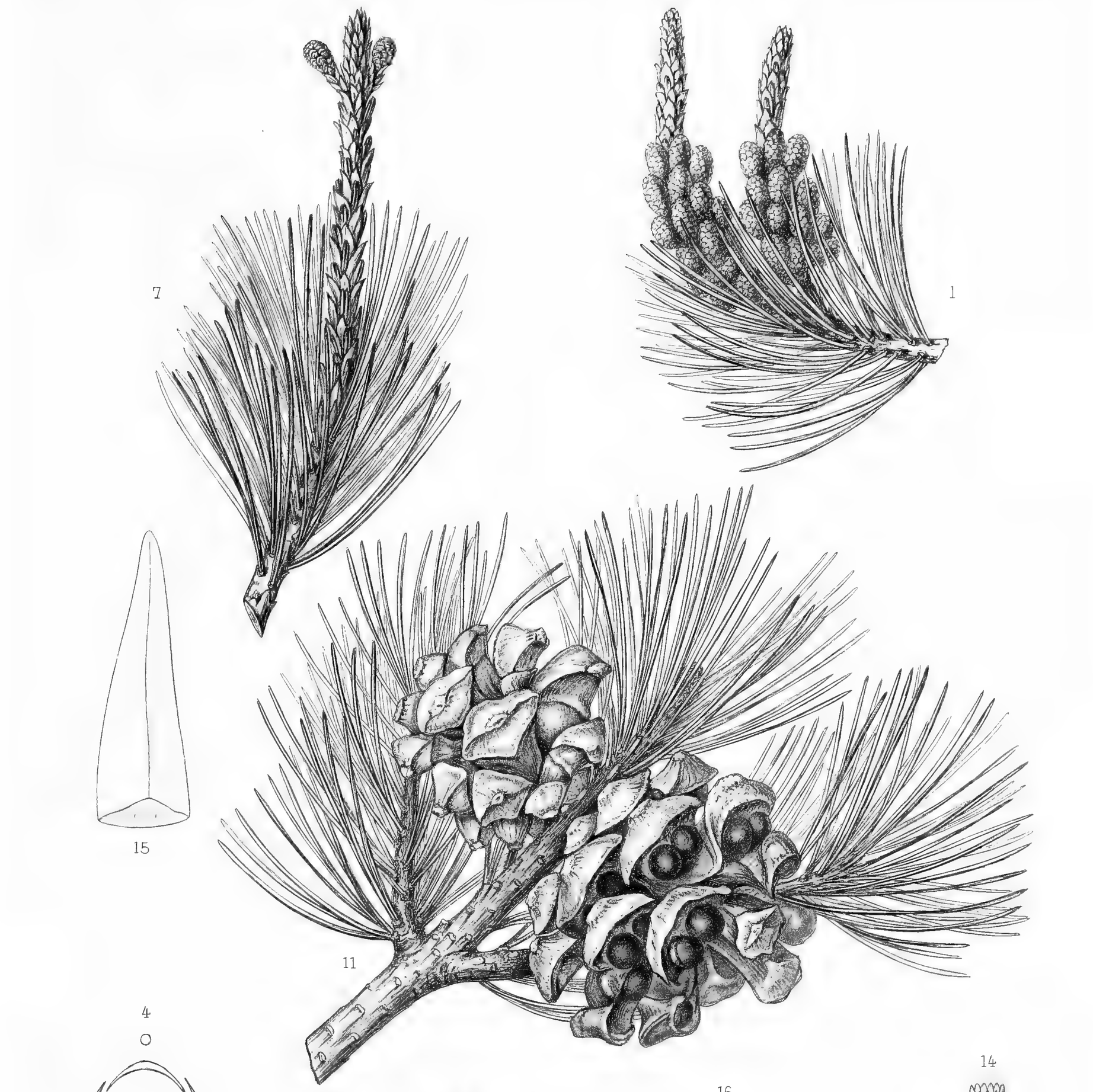
[8] See ix. 129.

[9] See ii. 34.

EXPLANATION OF THE PLATE.

PLATE DL. PINUS CEMBROIDES.

1. A branch with staminate flowers, natural size.
2. A staminate flower, enlarged.
3. A bract of a staminate flower, enlarged.
4. Diagram of the involucre of the staminate flower.
5. An anther, front view, enlarged.
6. An anther, side view, enlarged.
7. A branch with pistillate flowers, natural size.
8. A pistillate flower, enlarged.
9. A scale of a pistillate flower, upper side, with its ovules, enlarged.
10. A scale of a pistillate flower, lower side, with its bract, enlarged.
11. A fruiting branch, natural size.
12. A cone-scale, upper side, with its seeds, natural size.
13. Vertical section of a seed, enlarged.
14. An embryo, enlarged.
15. Tip of a leaf, enlarged.
16. Cross section of a leaf, magnified fifteen diameters.



C.E. Faxon del.

Rapine sc.

PINUS CEMBROIDES, Zuce

A Riocreux direx.t

Imp. J Taneur, Paris

PINUS MONOPHYLLA.

Nut Pine. Piñon.

LEAVES solitary or rarely in 2-leaved clusters, stout, rigid, spinescent, from $1\frac{1}{4}$ to $2\frac{1}{4}$ inches in length. Cones from $1\frac{1}{2}$ to $2\frac{1}{2}$ inches long.

Pinus monophylla, Torrey, *Frémont's Rep.* 319, t. 4 (1845). — Bolander, *Proc. Cal. Acad.* iii. 318. — Parlatore, *De Candolle Prodr.* xvi. pt. ii. 378. — Lawson, *Pinetum Brit.* i. 65, t. 9, f. 1–12. — Watson, *King's Rep.* v. 330. — K. Koch, *Dendr.* ii. pt. ii. 271. — Rothrock, *Pl. Wheeler*, 28, 50. — Engelmann, *Rothrock Wheeler's Rep.* vi. 259, 375; *Trans. St. Louis Acad.* iv. 178; *Brewer & Watson Bot. Cal.* ii. 124. — Masters, *Gard. Chron.* n. ser. xx. 48, f. 8; *Jour. R. Hort. Soc.* xiv. 234. — Sargent, *Forest Trees N. Am. 10th Census U. S.* ix. 190. — Lauche, *Deutsche Dendr.* ed. 2, 104. — Lemmon, *Rep. California State Board Forestry*, ii. 72, 88 (*Pines of the Pacific Slope*); *West-American Cone-Bearers*, 27. — Steele, *Proc. Am. Pharm. Assoc.* 1889, 234 (*The Pines of California*). — Mayr, *Wald. Nordam.* 241, t. 7, f. — Beissner, *Handb. Nadelh.* 254. — Hansen, *Jour. R. Hort. Soc.* xiv. 375 (*Pinetum Danicum*). — Coville, *Contrib. U. S. Nat. Herb.* iv. 222 (*Bot. Death Valley Exped.*). — Koehne, *Deutsche Dendr.* 33.

Pinus Fremontiana, Endlicher, *Syn. Conif.* 183 (1847). — Lawson & Son, *List No. 10, Abietineæ*, 45. — Dietrich, *Syn.* v. 401. — Gordon, *Jour. Hort. Soc. Lond.* iv. 293, f.; *Pinetum*, 194. — Knight, *Syn. Conif.* 28. — Lindley & Gordon, *Jour. Hort. Soc. Lond.* v. 216. — Carrière, *Traité Conif.* 406. — Henkel & Hochstetter, *Syn. Nadelh.* 62. — (Nelson) Senilis, *Pinaceæ*, 112. — Hoopes, *Evergreens*, 122. — Hansen, *Jour. R. Hort. Soc.* xiv. 361 (*Pinetum Danicum*).

Pinus edulis, var. **monophylla**, Torrey, *Ives' Rep.* pt. iv. 28 (1860).

A tree, usually fifteen or twenty, but occasionally from forty to fifty feet in height, with a short trunk rarely more than a foot in diameter, and often divided near the ground into several stout spreading stems. The short thick branches form, while the tree is young, a broad rather compact pyramid, and in old age, when they frequently become pendulous, a low round-topped and often picturesque head. The bark of the trunk is about three quarters of an inch in thickness, and is divided by deep irregular fissures into narrow connected flat ridges broken on the surface into thin closely appressed light or dark brown scales tinged with red or orange-color. The branch-buds are ovate, obtuse, about a quarter of an inch long, and covered by pale chestnut-brown scales. The branchlets are stout, and before the lengthening leaves emerge from the leaf-buds are hidden under the closely imbricated scales of the branch-buds; during their first winter they are light orange-color and then become light brown, gray, or brown tinged with green or orange-color, and at the end of three or four years dark brown. The primary leaves, which are the only ones produced during the first five or six years in the life of the plant, are linear-lanceolate, entire, strongly keeled, glaucous, and from three quarters of an inch to an inch in length, gradually becoming shorter as the buds of the earliest leaf-clusters are developed in their axils;[1] the secondary leaves are solitary and terete, or occasionally in two-leaved clusters and semiterete; they are rigid, incurved, entire, spinescent with long callous tips, pale glaucous green, and usually about an inch and a half long, although sometimes from one and a quarter to two and a quarter inches in length, with loose sheaths from a quarter to nearly half an inch long, the thin tips of the scales soon becoming much reflexed, and, when they fall, leaving the persistent bases of the sheaths; they are marked with from eighteen to twenty-six rows of stomata, and contain two or three resin ducts and a single fibro-vascular bundle;[2] the leaves sometimes begin to fall during their fourth and fifth

[1] *Gard. Chron.* n. ser. xx. f. 8.

[2] The solitary terete leaf of *Pinus monophylla* was formerly usually thought to consist of a pair of connate leaves, and this hypothesis appeared reasonable as the trees occasionally bear two-leaved clusters (Meehan, *Proc. Phil. Acad.* 1884, 295; *Bull. Torrey Bot. Club*, xii. 81. — Hooker f. *Gard. Chron.* n. ser. xxvi. 136, f. 24). But the internal structure of the leaf with its single fibro-vascular bundle shows that it is really one leaf, and the apparent anomaly

seasons, although some of them frequently remain on the branches until their twelfth year. The staminate flowers are oval, dark red, and about a quarter of an inch long, with anthers terminating in knobs or in minute teeth, and are usually surrounded by six involucral bracts. The pistillate flowers are lateral and oval, with thick rounded apiculate scales, and are raised on short stout peduncles covered by ovate lanceolate light chestnut-brown bracts. In the autumn the young cones are oblong, erect, and about half an inch long, and, beginning to grow very early the following spring, they are nearly half grown when the flowers open in May; at maturity they are from one and a half to two and a half inches in length, somewhat less in breadth, and bright green, with concave scales rounded at the apex, the exposed portion being much thickened, four-angled, and gradually narrowed into a prominent knob terminating in a truncate or slightly concave umbo furnished with a minute incurved tip; only a few of the middle scales, which are often three quarters of an inch across, are fertile; the others are much smaller, and those below the middle, gradually decreasing in size and remaining closed, form a broad base to the mature cone; after opening and shedding their seeds the cones become light chestnut-brown and lustrous, giving a reddish tone to the tree when they are abundant. The seeds are oblong, full and rounded at the base, acute at the apex, dark red-brown and rounded on the lower side, slightly compressed and pale yellow-brown on the upper side, about five eighths of an inch long and a quarter of an inch broad, with a thin brittle shell, an oily resinous albumen, and an embryo with from seven to ten cotyledons; their wings are membranaceous, light brown, from one third to one half of an inch wide, and remain attached to the scales after the seeds fall.

Pinus monophylla inhabits dry gravelly slopes and mesas, and is distributed from the western base of the Wasatch Mountains in Utah westward over the mountain ranges of the Great Basin, on which it usually forms, above elevations of six thousand feet, open forests with *Juniperus Utahensis*, generally ascending to higher altitudes than that tree;[1] on the eastern slopes of the southern Sierra Nevada it constitutes a nearly continuous belt between six and eight thousand feet above the sea, and crossing the range to the head-waters of King's River is common at an elevation of five thousand five hundred feet on the north wall of the cañon and on Paradise fork of the south fork at heights of between six and seven thousand feet.[2] In California it is also abundant on the desert mountains of the southeast, usually at elevations of between five and seven thousand feet and mingled with Junipers below and with *Pinus aristata* above, and ranges southwestward to the northern slopes of the San Bernardino[3] and San Jacinto Mountains,[4] crossing the southern boundary of the state into Lower California and maintaining on the slopes from the central table-land of the peninsula to the plains of the Colorado Desert a precarious foothold,[5] and to the Tehachapi Mountains, from which, along the sides of the cañon leading from the Tehachapi Valley to the Mohave Valley, it descends to three thousand seven hundred feet above the sea-level; it also dots the northern slopes of the San Emigdio Mountains,[6] at elevations of from six thousand to seven thousand feet, mixed with *Juniperus Californica*, and extends to the San Rafael Mountains, growing here down to elevations of three thousand feet.[7] It is common on the mesas of southern Utah; in Arizona it occupies a broad zone on the western slopes of the Virgin Mountains, grows in open forests along the southern rim of the Colorado plateau, and forms, on the Bradshaw, Mazatzal, and Mogollon Mountains south of the plateau,

in this genus of a single cylindrical leaf occupying the apex of a branchlet is explained by Masters (*Ann. Bot.* ii. 124), who, in studying the early development of the leaf-bud of *Pinus monophylla*, found always two foliar tubercles, one of them usually overpassing the other and obliterating all trace of a second leaf. (See, also, Bertrand, *Ann. Sci. Nat.* sér. 5, xx. 102, t. 9, f. 5, 6. — Coulter & Rose, *Bot. Gazette*, xi. 302.)

[1] Sargent, *Am. Jour. Sci.* ser. 3, xvii. 419 (*The Forests of Central Nevada*).

[2] *Teste* John Muir.

[3] S. B. Parish, *Zoë*, iv. 335.

[4] *Pinus monophylla* was found near the head of the San Felipe, on the edge of the Colorado Desert, California, by Mr. T. S. Brandegee in 1894.

[5] Orcutt, *Garden and Forest*, v. 184.

[6] *Teste* Miss Alice Eastwood.

[7] *Pinus monophylla* was collected on the San Rafael Mountains, a part of the great cross range which divides the central valley of California from the southwestern part of the state, in May, 1894, by Dr. F. Franceschi.

at elevations of about six thousand feet above the sea, a broad belt below the forests of *Pinus ponderosa* and above that occupied by small trees of *Pinus edulis*.

The wood of *Pinus monophylla* is light, soft, weak and brittle, and close-grained; it is yellow or light brown, with thick nearly white sapwood, and contains thin inconspicuous bands of small summer cells, a few resin passages, and numerous obscure medullary rays. The specific gravity of the absolutely dry wood is 0.5658, a cubic foot weighing 35.26 pounds.[1] It is largely used for fuel, furnishing the best wood[2] produced in the Great Basin for the manufacture of charcoal used in smelting.

The seeds supply an important article of food to the Paiutes, Shoshones, Panamints, and other desert Indians, who gather the cones in the autumn, and, heating them slightly to open the scales, pick out the seeds, which they store for winter use, eating them raw or roasted or pounding them into coarse flour.[3]

Pinus monophylla was discovered by Frémont near the Cajon Pass in southern California on April 18, 1844.[4] It is said to have been introduced into European gardens in 1847, and is occasionally cultivated in Europe and in the eastern United States, where it is hardy as far north, at least, as eastern Massachusetts. In cultivation, however, *Pinus monophylla* grows very slowly, and it is more valuable in gardens as a botanical curiosity than as an ornament.

[1] *Pinus monophylla* usually grows slowly. A specimen of the wood of a tree grown in central Nevada, which I examined in 1878, was five and a half inches in diameter and contained one hundred and thirteen layers of annual growth. (See *Am. Jour. Sci.* ser. 3, xvii. 419 [*The Forests of Central Nevada*].) The log specimen, however, in the Jesup Collection of North American Woods in the American Museum of Natural History, New York, brought from the same locality, is thirteen inches in diameter inside the bark and only one hundred and seventy-eight years old, with sapwood which is two and seven eighths inches thick and contains fifty-nine layers.

[2] *Pinus monophylla* perhaps grows to its largest size on Mt. Magruder, a high peak in Nevada northeast of Owen's Lake and not far from the boundary line of California, where it forms a luxuriant forest of trees forty or fifty feet in height, which is a favorite resort of Indians, who assemble there to gather the abundant crops of seeds. (See Merriam, *North American Fauna*, No. 7, 337 [*Death Valley Exped.* ii.].)

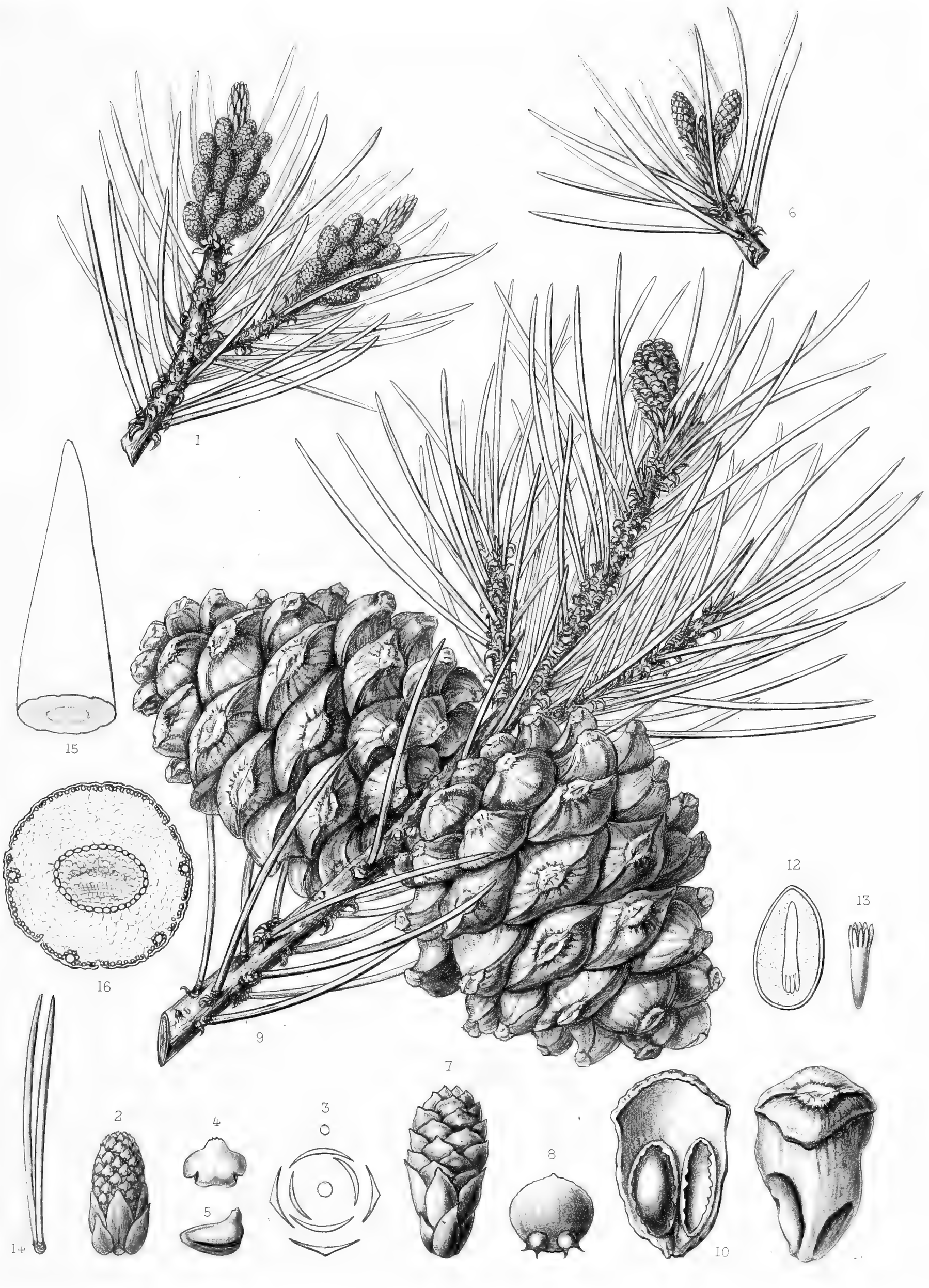
[3] Palmer, *Am. Nat.* xii. 594. — Deutcher, *American Anthropologist*, vi. 377 (*Piñon-gathering among the Panamint Indians*).

[4] Frémont, *Rep.* 258.

EXPLANATION OF THE PLATE.

PLATE DLI. PINUS MONOPHYLLA.

1. A branch with staminate flowers, natural size.
2. A staminate flower, enlarged.
3. Diagram of the involucre of the staminate flower.
4. An anther, front view, enlarged.
5. An anther, side view, enlarged.
6. An end of a branch with pistillate flowers, natural size.
7. A pistillate flower, enlarged.
8. A scale of a pistillate flower, upper side, with its ovules, enlarged.
9. A fruiting branch, natural size.
10. A cone-scale, upper side, with its seeds, natural size.
11. A cone-scale, under side, natural size.
12. Vertical section of a seed, enlarged.
13. An embryo, enlarged.
14. A two-leaved cluster of leaves, natural size.
15. Tip of a leaf, enlarged.
16. Cross section of a leaf, magnified fifteen diameters.



C.E Faxon del.

Rapine sc.

PINUS MONOPHYLLA, Torr.

A. Riocreux direx.t

Imp. J. Taneur, Paris.

PINUS EDULIS.

Nut Pine. Piñon.

LEAVES in 2 or 3-leaved clusters, stout, rigid, sharp-pointed, from $\frac{3}{4}$ of an inch to $1\frac{1}{2}$ inches in length. Cones from $1\frac{1}{4}$ to $1\frac{1}{2}$ inches long.

Pinus edulis, Engelmann, *Wislizenus Memoir of a Tour to Northern Mexico* (*Senate Doc.* 1848), Bot. Appx. 88; *Rothrock Wheeler's Rep.* vi. 260. — Lindley & Gordon, *Jour. Hort. Soc. Lond.* v. 216. — Carrière, *Rev. Hort.* 1854, 227; *Fl. des Serres*, ix. 201; *Traité Conif.* 408. — Torrey, *Sitgreaves' Rep.* 173, t. 20; *Pacific R. R. Rep.* iv. pt. v. 140; *Ives' Rep.* pt. iv. 28. — J. M. Bigelow, *Pacific R. R. Rep.* iv. pt. v. 3, 19. — Courtin, *Fam. Conif.* 92. — Henkel & Hochstetter, *Syn. Nadelh.* 415. — Hoopes, *Evergreens*, 142. — Parlatore, *De Candolle Prodr.* xvi. pt. ii. 398. — Porter & Coulter, *Fl. Colorado; Hayden's Surv. Misc. Pub.* No. 4, 130. — Rothrock, *Wheeler's Rep.* vi. 9. — Rusby, *Bull. Torrey Bot. Club*, ix. 106. — Veitch, *Man. Conif.* 172. — Hemsley, *Bot. Biol. Am. Cent.* iii. 186. — Sargent, *Forest Trees N. Am.* 10*th Census U. S.* ix. 190. — Coulter, *Man. Rocky Mt. Bot.* 432; *Contrib. U. S. Nat. Herb.* ii. 554 (*Man. Pl. W. Texas*). — Mayr, *Nordam. Holz.* 240, t. 7, f. — Merriam, *North American Fauna*, No. 3, 122. — Beissner, *Handb. Nadelh.* 252. — Masters, *Jour. R. Hort. Soc.* xiv. 228. — Hansen, *Jour. R. Hort. Soc.* xiv. 358 (*Pinetum Danicum*). — Koehne, *Deutsche Dendr.* 33. — Lemmon, *West American Cone-Bearers*, 26.

Pinus monophylla, var. **edulis**, M. E. Jones, *Zoë*, ii. 251 (1891).

A tree, rarely thirty or forty feet in height, with a short often divided trunk occasionally two and a half feet in diameter, but usually much smaller, and often not more than twelve or fifteen feet tall. During its early years, when the branches are horizontal, it forms a broad-based compact pyramid, and in old age a dense low round-topped broad head. The bark of the trunk is from one half to three quarters of an inch in thickness and is irregularly divided into connected ridges covered by small closely appressed light brown scales tinged with red or orange-color. The branch-buds are ovate, acute, from one third to one half of an inch in length, with light chestnut-brown scales thin and scarious on the margins. The branchlets are stout, and when they first appear are covered with the conspicuous closely imbricated scales of the branch-buds, which, withering during the first season, do not entirely disappear until the third; they are light orange-color during their first and second years, and then turn from light gray-brown to dark brown sometimes tinged with red. The sheaths of the leaf-clusters are close, light brown, scarious, more or less laciniate on the margins, and from one quarter to one half of an inch in length; they begin to curl back during the first winter, and mostly disappear during the third and fourth years. The primary leaves are linear-lanceolate, entire, strongly keeled, glaucous, marked by numerous rows of stomata, and nearly an inch in length; the secondary leaves are produced in two or rarely in three-leaved clusters, and are stout, semiterete, or triangular in the three-leaved clusters, entire, rigid, incurved, acute with callous tips, dark green, and from three quarters of an inch to an inch and a half long; they are marked with from five to fifteen rows of stomata and contain a single fibro-vascular bundle and two resin ducts;[1] the leaves begin to fall during the third or not until the fourth or fifth year, and drop very irregularly, some of them remaining on the branches for eight or nine years. The staminate flowers are oval and about a quarter of an inch long, with dark red anthers terminating in knobs or short spurs, and are surrounded by involucres of four bracts. The pistillate flowers are subterminal, oblong, and about a quarter of an inch in length, with slightly thickened rounded and apiculate scales, and are raised on short stout peduncles covered by ovate acute light chestnut-brown bracts. At the end of their first summer the young cones are oblong, erect, dark reddish brown, and about three quarters of an inch in length, and when fully grown the following

[1] Coulter & Rose, *Bot. Gazette*, xi. 303.

summer are from a quarter of an inch to an inch and a half long, almost as broad, and light green, with concave scales rounded at the apex, the exposed portion being much thickened, conspicuously transversely keeled, and narrowed into a four-angled central knob which terminates in the large light brown slightly concave umbo furnished with a minute incurved tip; only the central scales, which are about half an inch broad, are fertile; the others are smaller and below the middle decrease rapidly in size, and, remaining closed, form a broad base to the mature cone, which becomes light brown and lustrous in its exposed parts, the base of the scales being dull light red, while the umbos are usually covered with a thick coat of resin. The seeds are ovate, acute, full and rounded at the base, semicylindrical or more or less compressed by pressure against the bracts of the scales above them, dark red-brown on the lower and light orange-color or yellow on the upper side, and about half an inch long, with a thin brittle shell, an oily resinous albumen, and an embryo with from seven to ten cotyledons; their wings are membranaceous, light reddish brown, about an eighth of an inch wide, and when the seeds fall remain attached to the cone-scales.[1]

Pinus edulis is distributed from the eastern foothills of the outer ranges of the Rocky Mountains of Colorado south of the divide between the waters of the Platte and the Arkansas Rivers, usually forming with *Juniperus monosperma* and *Pinus ponderosa* open forests at elevations between six and eight thousand feet above the sea-level, westward through Colorado to the eastern borders of Utah and to the valley of Little Snake River in southwestern Wyoming; at the head of the Arkansas, at elevations between eight and nine thousand feet above the sea, it covers the broad Buena Vista valley with an open forest in which *Pinus ponderosa* is its principal associate; mixed with *Juniperus Utahensis* it dots the hills and table-lands of western Colorado, descending in the valleys of White and Grand Rivers to elevations of less than five thousand feet above the sea-level; it ranges southward over the Rocky Mountains of New Mexico to the Guadalupe, Limpio, Organ, and Chicos Mountains of western Texas, and grows also in Texas on the bluffs at the great bend of the Rio Grande, on the forks of the Nueces River, and on the border of the high plateau of the Staked Plain;[2] it extends southward over the mountains of northern Mexico and westward to northern and central Arizona, where with Junipers it abounds on the Colorado plateau, and on the Bradshaw, Mogollon, Pinal, Superstition, Caliuro, and other mountain ranges south of it,[3] forms a well marked forest belt at elevations between six and seven thousand feet above the sea and below the forests of *Pinus ponderosa*.[4]

The wood of *Pinus edulis* is light, soft, not strong, brittle, close-grained, and durable in contact with the soil; it is pale brown, with thin nearly white sapwood, and contains thin inconspicuous bands of small summer cells, few resin passages, and many obscure medullary rays; the specific gravity of the absolutely dry wood is 0.6388, a cubic foot weighing 39.81 pounds. It is largely used for fuel, for fencing, and in the manufacture of charcoal for smelting purposes, and in western Texas is occasionally sawed into lumber.[5]

The sweet edible seeds form an important article of food among Indians and Mexicans,[6] and are

[1] Some good observers have considered *Pinus edulis* as a two-leaved form of *Pinus monophylla*, and that the two forms are connected by trees in southern Utah with foliage about equally divided between the one and the two-leaved clusters. (See Newberry, *Bull. Torrey Bot. Club*, xii. 50; xiii. 183. — Meehan, *Bull. Torrey Bot. Club*, xii. 81. — M. E. Jones, *Zoë*, ii. 251; iii. 307.)

But in spite of the general resemblance in the habit and the similarity in leaf structure of the two trees, *Pinus edulis*, in its much more slender less spinescent usually shorter and darker green leaves sometimes borne in clusters of three, and in its smaller cones, appears to differ sufficiently from *Pinus monophylla*, which inhabits more arid regions, to justify their specific separation. I have never seen the two forms growing together or passing one into the other, and all the two-leaved specimens from southern Utah which I have been able to examine appear distinctly to belong to *Pinus monophylla*, which frequently produces leaves in clusters of two. (See Hooker f. *Gard. Chron.* n. ser. xxvi. 136.)

[2] Havard, *Proc. U. S. Nat. Mus.* viii. 503.

[3] Toumey, *Garden and Forest*, x. 152.

[4] Merriam, *North American Fauna*, No. 3, 122.

[5] *Pinus edulis* grows slowly. The log specimen in the Jesup Collection of North American Woods in the American Museum of Natural History, New York, is six and three quarters inches in diameter inside the bark and has three hundred and sixty-nine layers of annual growth, with twenty-seven layers of sapwood which is half an inch in thickness.

[6] Newberry, *Popular Science Monthly*, xxxii. 35 (*Food and Fibre Plants of the North American Indians*).

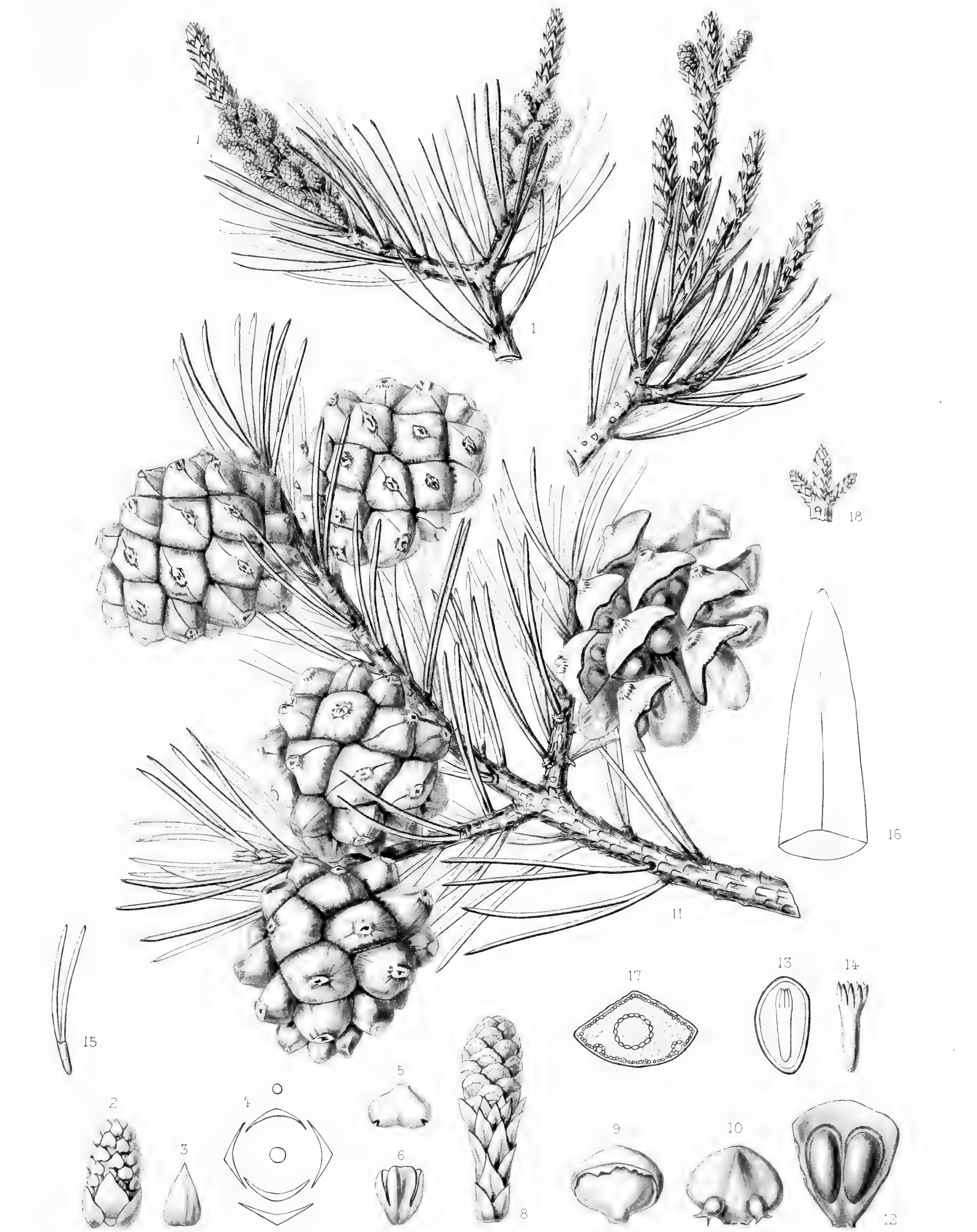
offered for sale in the markets of Colorado and New Mexico, and rarely in those of the cities of the eastern states.

Pinus edulis was discovered in 1846 in the valley of the Rio Grande in New Mexico by Dr. F. A. Wislizenus. It is occasionally cultivated in the gardens of the eastern United States, where it is perfectly hardy as far north as eastern Massachusetts, and in those of Europe. In cultivation, however, it grows very slowly, forming a rather compact pyramidal bush, and shows no tendency as yet to assume the picturesque habit of its mature years.

EXPLANATION OF THE PLATE.

PLATE DLII. PINUS EDULIS.

1. A branch with staminate flowers, natural size.
2. A staminate flower, enlarged.
3. Bract of a staminate flower, enlarged.
4. Diagram of the involucre of the staminate flower.
5. An anther, front view, enlarged.
6. An anther, rear view, enlarged.
7. A branch with pistillate flowers, natural size.
8. A pistillate flower, enlarged.
9. A scale of a pistillate flower, lower side, with its bract, enlarged.
10. A scale of a pistillate flower, upper side, with its ovules, enlarged.
11. A fruiting branch, natural size.
12. A cone-scale, upper side, with its seeds, natural size.
13. Vertical section of a seed, enlarged.
14. An embryo, enlarged.
15. A cluster of leaves with its sheath, natural size.
16. Tip of a leaf, enlarged.
17. Cross section of a leaf, magnified fifteen diameters.
18. Winter branch-buds, natural size.



C.E. Faxon del. *Himely sc.*

PINUS EDULIS, Engelm.

A. Riocreux direx.t *Imp. J. Taneur, Paris.*

PINUS BALFOURIANA.

Foxtail Pine.

LEAVES in 5-leaved clusters, rigid, incurved, from 1 to 1½ inches in length. Cones subcylindrical, from 3½ to 5 inches long, their scales furnished with minute incurved persistent spines.

Pinus Balfouriana, A. Murray, *Oregon Exped.* i. t. 3, f. 1 (1853). — Gordon, *Pinetum*, 217. — Henkel & Hochstetter, *Syn. Nadelh.* 109. — Bolander, *Proc. Cal. Acad.* iii. 318. — Carrière, *Traité Conif.* ed. 2, 425. — (Nelson) Senilis, *Pinaceæ*, 104. — Hoopes, *Evergreens*, 149. — Engelmann, *Trans. St. Louis Acad.* iv. 179; *Brewer & Watson Bot. Cal.* ii. 125. — Veitch, *Man. Conif.* 175. — Lawson, *Pinetum Brit.* i. 11, f. 1–5. — Sargent, *Forest Trees N. Am. 10th Census U. S.* ix. 191. — Lemmon, *Rep. California State Board Forestry*, ii. 71, 86, t. (*Pines of the Pacific Slope*); *West-American Cone-Bearers*, 26. — Steele, *Proc. Am. Pharm. Assoc.* 1889, 234 (*The Pines of California*). — Mayr, *Wald. Nordam.* 354, t. 7, f. — Beissner, *Handb. Nadelh.* 272. — Masters, *Jour. R. Hort. Soc.* xiv. 225. — Hansen, *Jour. R. Hort. Soc.* xiv. 349 (*Pinetum Danicum*). — Merriam, *North American Fauna*, No. 7, 339 (*Death Valley Exped.* ii.). — Coville, *Contrib. U. S. Nat. Herb.* iv. 221 (*Bot. Death Valley Exped.*). — Koehne, *Deutsche Dendr.* 32.

A tree, usually thirty or forty feet in height, with a short trunk from twelve to twenty-four inches in thickness, but occasionally ninety feet high, with a tall straight tapering stem five feet in diameter.[1] In early life the short stout branches stand out from the stem in regular whorls, and form a narrow compact pyramid; later they turn upward, and in middle life a few of the specialized upper branches, growing more rapidly than the others and than those below them, push out and become long, pendulous, and often contorted, forming the open irregular and picturesque usually pyramidal head of the mature tree, with mostly erect upper branches and long rigid more or less spreading branchlets clothed at the extremities only with dense brush-like masses of lustrous foliage. On the stems and branches of young trees the bark is thin, smooth, and snow-white; and on old trunks it is from one half to three quarters of an inch in thickness, dark red-brown and deeply divided into broad connected flat ridges broken by cross fissures into nearly square plates, separating on the surface into small closely appressed scales; or, when the outer scales are worn away by the storms of the Sierras, the bark is bright cinnamon-red. The branchlets are stout, and when they first appear are slightly puberulous and dark orange-brown, becoming after a few seasons dark gray-brown or sometimes nearly black, and for many years are roughened by the persistent thickened dark brown bases of the scales of the branch-buds. These are broadly ovate, gradually contracted and long-pointed at the apex, and covered by ovate acute light chestnut-brown lustrous scales, the terminal bud being about one third of an inch in length and nearly twice as large as the lateral buds. The leaves are crowded, pressed against the branches, and borne in clusters of five, their bud-scales forming loose scarious sheaths about an eighth of an inch in length, the upper portion soon becoming reflexed, withering and falling off, while the thicker base does not entirely disappear until the end of several years; they are stout, rigid, incurved, acute at the apex with thick callous tips, entire, dark green and lustrous on the back, pale and marked on the two ventral faces with numerous conspicuous rows of stomata, and from an inch to an inch and a half long; they contain a single fibro-vascular bundle and two dorsal resin ducts surrounded by strengthening cells, which also occur under the epidermis usually in two layers, but at the angles of the leaf often in three;[2] forming dense brush-like tufts from twelve to eighteen inches in length at the extremities of the wand-like branches, they persist for ten or twelve years. The staminate flowers,

[1] Muir, *The Mountains of California*, 216 (as *Pinus aristata*).

[2] Coulter & Rose, *Bot. Gazette*, xi. 304.

which are borne in short crowded spikes, are oval and about half an inch in length, with dark orange-red anthers terminating in short irregularly denticulate crests, and are surrounded by four involucral bracts. The pistillate flowers are subterminal, oblong-oval, and nearly half an inch long, with dark purple ovate acute pointed scales, and are raised on stout peduncles from one half to three quarters of an inch in length and covered by thin light chestnut-brown ovate acute bracts. In the autumn the young cones are erect, dark purple, and from three quarters of an inch to nearly an inch in length; they become horizontal the following spring, and, growing rapidly, are soon pendulous, and when fully grown at midsummer they are subcylindrical, from three and a half to five inches long, from an inch and a half to an inch and three quarters wide, and dark purple, with elongated narrow slightly concave scales rounded at the apex, the much thickened exposed parts being conspicuously transversely keeled and terminating in oblong dark concave umbos furnished with slender minute incurved spines; after opening, the scales, with the exception of the umbos, turn dull red-brown or mahogany color. The seeds are full and rounded above, acute and compressed at the base, pale and conspicuously mottled with dark purple, and nearly a third of an inch in length, with a thin crustaceous coat and an embryo with five cotyledons; their wings are gradually narrowed and oblique at the apex, pale, an inch long, and about a quarter of an inch wide.

Pinus Balfouriana, which grows always on rocky mountain slopes and ridges, inhabits Scott Mountain directly west of Mt. Shasta in Siskiyou County, California, where, below scattered groves of *Pinus albicaulis*, it forms an open forest at elevations between five and eight thousand feet above the sea-level; it occurs near the timber line on the mountains at the head of the Sacramento River, on Yolo Bally[1] and on the southern Sierra Nevada along the slopes of Mt. Whitney and about the head-waters of King's, Kaweah, and Kern Rivers, where, either alone or mixed below with *Pinus contorta*, var. *Murrayana*, and above with *Pinus monticola*, it sometimes makes extensive open groves at elevations between nine thousand and eleven thousand five hundred feet, growing here to its largest size, but on the upper borders of the forest, where it is usually the only species, sometimes reduced to a low shrub.

The wood of *Pinus Balfouriana* is light, soft, close-grained, weak and brittle, with a satiny surface susceptible of receiving a good polish. It contains narrow dark-colored bands of small summer cells, few inconspicuous resin passages, and numerous obscure medullary rays. The specific gravity of the absolutely dry wood is 0.5434, a cubic foot weighing 33.86 pounds.

Pinus Balfouriana was introduced into Scotch gardens in 1852 by its discoverer, John Jeffrey, who found it in that year on Scott Mountain, but, like many other alpine trees, it grows very slowly at the sea-level, and, although hardy in Great Britain, gives no promise of attaining beauty or size.[2]

In its specific name this tree commemorates John Hutton Balfour.[3]

[1] *Pinus Balfouriana* was found by Mr. T. S. Brandegee on Yolo Bally, a high peak of the California Coast Range west of Red Bluff in latitude 40° 13′ north, (*Zoë*, iv. 176).

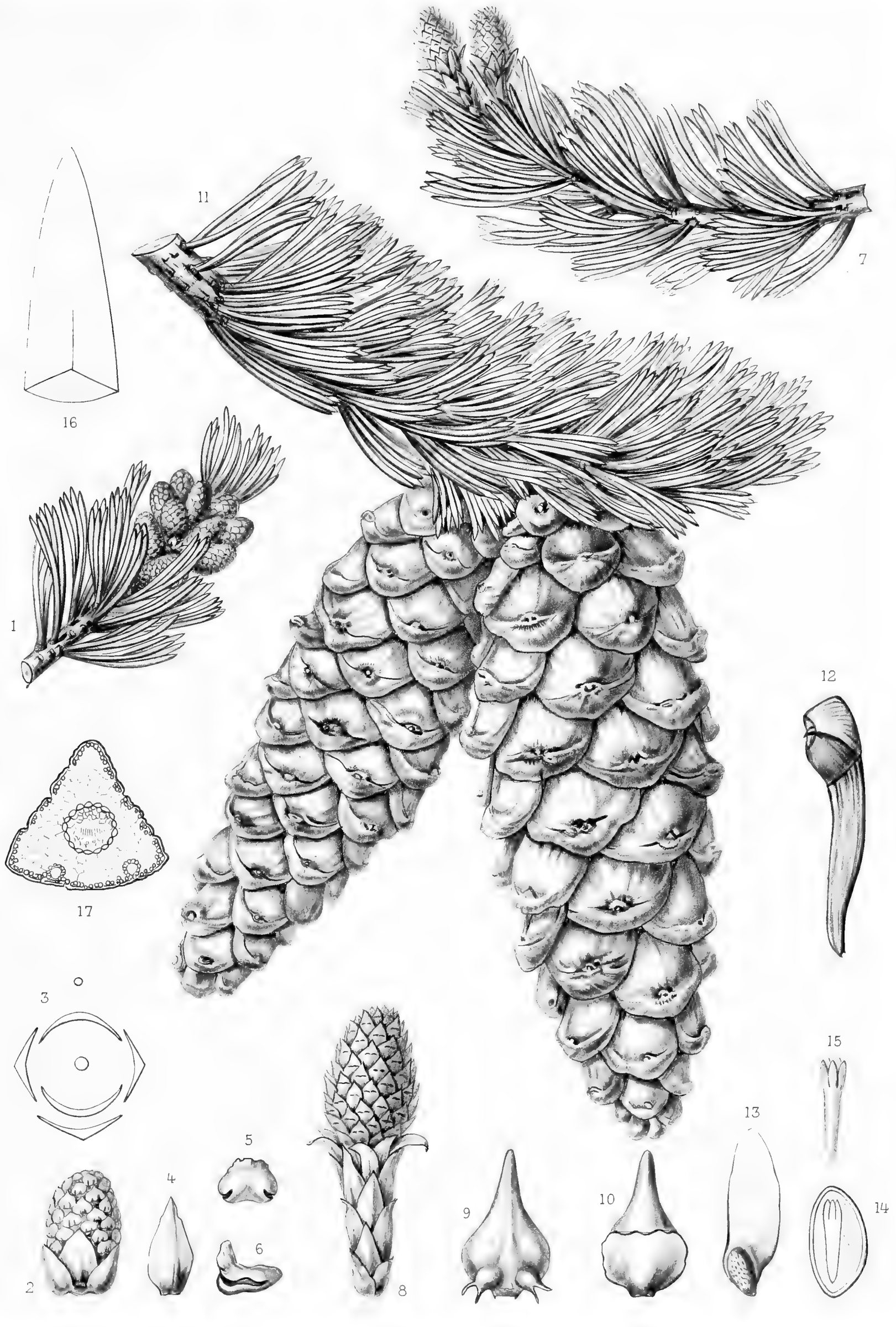
[2] Fowler, *Gard. Chron.* 1872, 973.

[3] John Hutton Balfour (September 15, 1808–February 11, 1884) was born and died in Edinburgh, where he was long a prominent member of the medical faculty of the University. In 1841 he succeeded Dr. Hooker in the chair of botany at Glasgow, but four years later returned to Edinburgh as professor of botany in the University and Regius Keeper of the Royal Botanic Garden, and continued to fill these positions until nearly the end of his life. In 1836 Professor Balfour was one of the founders of the Botanical Society of Edinburgh, and for years he was a most successful teacher of botany. He was the author of a *Flora of Edinburgh*, a manual of botany, a class-book of botany, of other text-books which have exerted a wide and lasting influence upon the study of this science in Scotland, and of many papers published in the proceedings of learned societies. He greatly improved and enlarged the garden under his charge, which, during his administration, became one of the chief horticultural and botanical centres of Europe; and as secretary of the association which sent Jeffrey to America, he was largely instrumental in the discovery and cultivation of several North American trees. *Balfourodendron*, a tree of southern Brazil of the Rue family, was dedicated to Professor Balfour by Joaquim Correa de Méllo.

EXPLANATION OF THE PLATE.

Plate DLIII. Pinus Balfouriana.

1. A branch with staminate flowers, natural size.
2. A staminate flower, enlarged.
3. Diagram of the involucre of the staminate flower.
4. Bract of a staminate flower, enlarged.
5. An anther, front view, enlarged.
6. An anther, side view, enlarged.
7. A branch with pistillate flowers, natural size.
8. A pistillate flower, enlarged.
9. A scale of a pistillate flower, upper side, with its ovules, enlarged.
10. A scale of a pistillate flower, lower side, with its bract, enlarged.
11. A fruiting branch, natural size.
12. A cone-scale, side view, natural size.
13. A seed, natural size.
14. Vertical section of a seed, enlarged.
15. An embryo, enlarged.
16. Tip of a leaf, enlarged.
17. Cross section of a leaf, magnified fifteen diameters.



C.E.Faxon del.

Himely sc.

PINUS BALFOURIANA, A. Murr.

A.Riocreux direx.t

Imp. J. Taneur, Paris.

PINUS ARISTATA.

Foxtail Pine. Hickory Pine.

LEAVES in 5-leaved clusters, rigid, incurved, from 1 to 1½ inches in length. Cones ovate, from 3 to 3½ inches long, their scales furnished with long slender awn-like prickles.

Pinus aristata, Engelmann, *Am. Jour. Sci.* ser. 2, xxxiv. 331 (1862); *Trans. St. Louis Acad.* ii. 205, t. 5, 6; *Linnæa*, xxxiii. 383. — Regel, *Gartenflora*, xii. 391. — Henkel & Hochstetter, *Syn. Nadelh.* 417. — (Nelson) Senilis, *Pinaceæ*, 103. — Carrière, *Traité Conif.* ed. 2, 424. — Sénéclauze, *Conif.* 113. — Parlatore, *De Candolle Prodr.* xvi. pt. ii. 400. — Porter & Coulter, *Fl. Colorado; Hayden's Surv. Misc. Pub.* No. 4, 130. — Gordon, *Pinetum*, ed. 2, 291. — Lawson, *Pinetum Brit.* i. 5, f. 1. — Schübeler, *Virid. Norveg.* i. 392. — Steele, *Proc. Am. Pharm. Assoc.* 1889, 234 (*The Pines of California*). — Mayr, *Wald. Nordam.* 353, t. 8, f. — Merriam, *North American Fauna*, No. 3, 122; No. 7, 339 (*Death Valley Exped.* ii.). — Coville, *Contrib. U. S. Nat. Herb.* iv. 220 (*Bot. Death Valley Exped.*).

Pinus Balfouriana, Watson, *King's Rep.* v. 331 (not A. Murray) (1871); *Pl. Wheeler*, 17.

Pinus Balfouriana, var. **aristata**, Engelmann, *Rothrock Wheeler's Rep.* vi. 375 (1878); *Brewer & Watson Bot. Cal.* ii. 125. — Veitch, *Man. Conif.* 175. — Sargent, *Forest Trees N. Am. 10th Census U. S.* ix. 191. — Coulter, *Man. Rocky Mt. Bot.* 432. — Beissner, *Handb. Nadelh.* 273. — Masters, *Jour. R. Hort. Soc.* xiv. 225. — Hansen, *Jour. R. Hort. Soc.* xiv. 349 (*Pinetum Danicum*). — Koehne, *Deutsche Dendr.* 32.

A bushy tree, occasionally forty or fifty feet in height, with a short trunk from two to three feet in diameter, or at high elevations usually reduced to a low shrub with gnarled semiprostrate stems. Strictly pyramidal while young, with regular whorls of short stout horizontal branches, later it becomes irregular in outline and often very picturesque by the greater development of some of the specialized upper branches, which are usually erect or slightly spreading and much longer and stouter than the often pendulous lower branches. On the stems and branches of young trees the bark is thin, smooth, milky white, and filled with resin vesicles which remain between the layers of old bark, and on mature trees it is from one half to three quarters of an inch in thickness, red-brown, and irregularly divided into broad flat connected ridges separating on the surface into small closely appressed scales. The branchlets are stout, bright orange-colored, and glabrous or at first slightly puberulous, usually becoming dark gray-brown or occasionally nearly black, and for many years roughened by the blackened rigid bases of the ovate acuminate light brown scales of the branch-buds. These are broadly ovate and acute, with more or less reflexed scales, the terminal bud being often one third of an inch long and nearly twice as large as the lateral buds. The leaves are borne in clusters of five and are crowded and pressed against the branch, forming compact round brush-like tufts from twelve to eighteen inches in length at the extremities of the naked branches, their bud-scales lengthening into thin compact sheaths about half an inch long, white and scarious above and firmer and pale chestnut-brown below, the upper portion soon becoming reflexed and gradually disappearing; they are stout or slender, incurved, from an inch to an inch and a half long, entire, acute with short callous tips, dark green and lustrous on the back, and marked with narrow rows of pale stomata on the two ventral faces; they contain a single fibro-vascular bundle and one or two resin ducts situated near the middle of the dorsal face and usually surrounded by an interrupted row of strengthening cells which also occur in a single layer under the epidermis, or on the dorsal face and at the angles occasionally in two layers;[1] they often begin to fall at the end of ten or twelve years, or are persistent for four or five years longer. The staminate flowers

[1] Coulter & Rose, *Bot. Gazette*, xi. 304.

are borne in short crowded spikes and are oval and about half an inch in length, with dark orange-red anthers terminating in obscurely denticulate crests, and are surrounded by four involucral bracts. The pistillate flowers are subterminal, solitary or in pairs, oblong-oval and about one third of an inch in length, with broadly ovate dark purple scales abruptly narrowed into long slender awns, and are raised on short stout peduncles covered by oblong pointed light chestnut-brown bracts. During the winter the young cones are broadly ovate, erect, and about an inch long and half an inch broad; beginning to grow the following June when the flowers open, they soon become horizontal and then semipendent, and when fully grown at midsummer they are ovate, dark purple-brown, nearly sessile, and from three to three and a half inches long and about an inch and a half wide, with thin narrow scales rounded at the apex, the exposed portions being almost equally four-sided and only slightly thickened and transversely keeled, with central elevated knob-like umbos terminating in slender incurved light red-brown prickles often nearly a quarter of an inch in length and so brittle that they frequently break from the mature cone; the cones open and shed their seeds late in September or in October, the exposed portion of the scales becoming dark purple-brown and the remainder dull red. The seeds are nearly oval, compressed, light brown conspicuously mottled with black, and about a quarter of an inch in length, with a thin crustaceous coat and an embryo with six or seven cotyledons; their wings are broadest at the middle, light brown, about one third of an inch long and often a quarter of an inch broad.

Nowhere very abundant and found only on a few mountain ranges, *Pinus aristata* grows on high rocky or gravelly slopes, and is distributed from the outer range of the Rocky Mountains of Colorado, where it is scattered through the upper borders of the forest between eight and twelve thousand feet above the sea-level,[1] westward to the mountain ranges of southern Utah, central and southern Nevada,[2] southwestern California,[3] and the San Francisco peaks of northern Arizona.[4] It rarely forms pure forests, being usually mixed below with *Pinus flexilis* and above with *Picea Engelmanni*, and reaches the upper limits of tree-growth, where it is frequently shrubby with short contorted stems.

The wood of *Pinus aristata* is light, soft, not strong, and close-grained; it is red, with thin nearly white sapwood, and contains thin dark-colored inconspicuous bands of small summer cells, few resin passages, and numerous obscure medullary rays.[5] The specific gravity of the absolutely dry wood is 0.5572, a cubic foot weighing 34.72 pounds. It is occasionally used for the timbers of mines and for fuel.

Pinus aristata was first made known to science by Dr. C. C. Parry, who discovered it on Pike's Peak, Colorado, in 1861,[6] and the following year sent seeds to the Botanic Garden of Harvard College. In the Atlantic States *Pinus aristata* grows very slowly, the plants raised from Dr. Parry's seeds being after thirty-five years only about two feet high; in England it grows more vigorously and has produced cones.[7]

[1] Parry, *Trans. St. Louis Acad.* ii. 123. — Rothrock, *Wheeler's Rep.* vi. 8, 9 (as *Pinus Balfouriana*). — Brandegee, *Bot. Gazette*, iii. 32.

[2] The upper slopes of Prospect Mountain in central Nevada between seven thousand five hundred and eight thousand feet above the sea-level were formerly covered with an open forest of *Pinus aristata*. These trees have nearly all been cut to timber the mines in the neigboring town of Eureka. (See Sargent, *Am. Jour. Sci.* ser. 3, xvii. 419 [*The Forests of Central Nevada*], as *Pinus Balfouriana*.)

[3] In California *Pinus aristata* occurs on the summits of the Panamint and Inyo Mountains, and it is said to grow on the high Sierra Nevadas east of the Yosemite Valley (Lemmon, *Rep. California State Board of Forestry*, ii. 71, 87 [*Pines of the Pacific Slope*]; *West-American Cone-Bearers*, 26), but I have not seen specimens of this tree from any part of the Sierras.

[4] On the San Francisco peaks *Pinus aristata* forms the timber line with *Picea Engelmanni* at about eleven thousand five hundred feet above the sea; here it is only a prostrate shrub, but descending to nine thousand feet, where it is mingled with *Pinus flexilis*, it frequently attains a height of thirty or forty feet.

[5] *Pinus aristata* probably always grows slowly. The log specimen in the Jesup Collection of North American Woods in the American Museum of Natural History, New York, cut near Eureka, in central Nevada, is eighteen inches in diameter inside the bark and two hundred and eighty-nine years old, the sapwood being five eighths of an inch thick, with forty-four layers of annual growth.

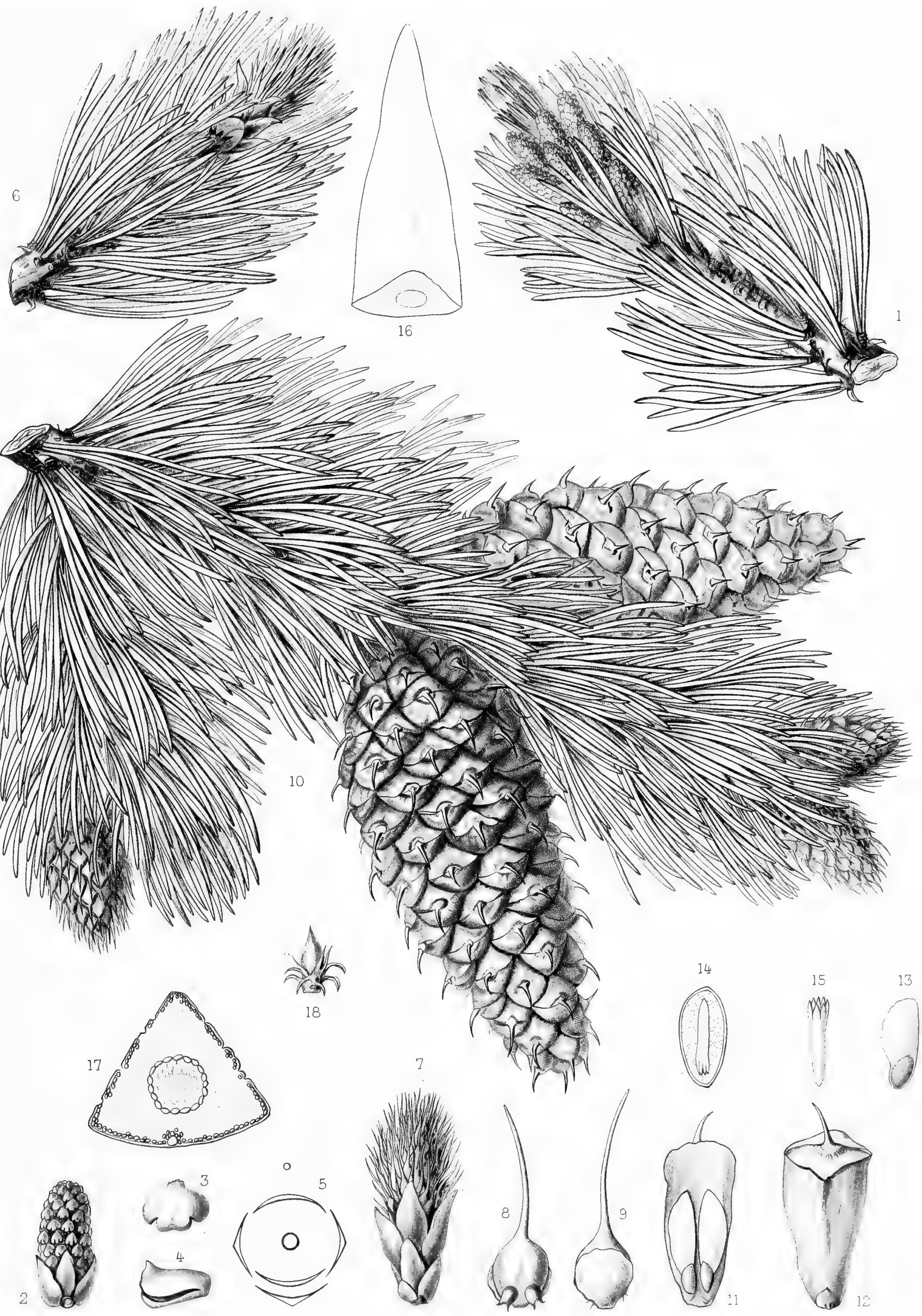
[6] A Pine branch without cones collected by Captain J. W. Gunnison, U. S. Army, in 1853, in the Coochetopa Pass, Colorado, at an elevation of ten thousand feet, was believed by Engelmann to be of this species.

[7] Webster, *Gard. Chron.* ser. 3, xx. 719, f. 126.

EXPLANATION OF THE PLATE.

Plate DLIV. Pinus aristata.

1. A branch with staminate flowers, natural size.
2. A staminate flower, enlarged.
3. An anther, front view, enlarged.
4. An anther, side view, enlarged.
5. Diagram of the involucre of the staminate flower.
6. A branch with pistillate flowers, natural size.
7. A pistillate flower, enlarged.
8. A scale of a pistillate flower, upper side, with its ovules, enlarged.
9. A scale of a pistillate flower, lower side, with its bract, enlarged.
10. A fruiting branch, natural size.
11. A cone-scale, upper side, with its seeds, natural size.
12. A cone-scale, lower side, with its bract, natural size.
13. A seed, natural size.
14. Vertical section of a seed, enlarged.
15. An embryo, enlarged.
16. Tip of a leaf, enlarged.
17. Cross section of a leaf, magnified fifteen diameters.
18. A winter branch-bud, natural size.



C.E.Faxon del. *Lövendal sc.*

PINUS ARISTATA, Engelm.

A.Riocreux direx.t *Imp. J.Taneur, Paris.*

PINUS RESINOSA.

Red Pine. Norway Pine.

LEAVES in 2-leaved clusters, slender, dark green, from 5 to 6 inches in length. Cones ovate-conical, from 2 to $2\frac{1}{4}$ inches long, their scales slightly thickened, unarmed.

Pinus resinosa, Aiton, *Hort. Kew.* iii. 367 (1789). — Lambert, *Pinus*, i. 20, t. 14. — Willdenow, *Spec.* iv. pt. i. 496; *Enum.* 988; *Berl. Baumz.* ed. 2, 267. — Poiret, *Lamarck Dict.* v. 339. — Persoon, *Syn.* ii. 578. — Desfontaines, *Hist. Arb.* ii. 612. — Du Mont de Courset, *Bot. Cult.* ed. 2, vi. 459. — Pursh, *Fl. Am. Sept.* ii. 642. — Nuttall, *Gen.* ii. 223. — Hayne, *Dendr. Fl.* 173. — Sprengel, *Syst.* iii. 886. — Lawson & Son, *Agric. Man.* 347; *List No. 10, Abietineæ*, 41. — Forbes, *Pinetum Woburn.* 19, t. 6. — Hooker, *Fl. Bor.-Am.* ii. 161 (in part). — Bigelow, *Fl. Boston.* ed. 3, 384. — Antoine, *Conif.* 7, t. 4, f. 1. — Link, *Linnæa*, xv. 501. — Endlicher, *Syn. Conif.* 178. — Knight, *Syn. Conif.* 27. — Richardson, *Arctic Searching Exped.* ii. 315. — Lindley & Gordon, *Jour. Hort. Soc. Lond.* v. 519. — Dietrich, *Syn.* v. 400. — Gordon, *Pinetum*, 183 (excl. syn. *Pinus Loiseleuriana*). — Hoopes, *Evergreens*, 102. — Parlatore, *De Candolle Prodr.* xvi. pt. ii. 388. — K. Koch, *Dendr.* ii. pt. ii. 286. — Nördlinger, *Forstbot.* 396. — Engelmann, *Trans. St. Louis Acad.* iv. 179. — Veitch, *Man. Conif.* 159. — Sargent, *Forest Trees N. Am. 10th Census U. S.* ix. 191. — Lauche, *Deutsche Dendr.* ed. 2, 106. — Regel, *Russ. Dendr.* ed. 2, pt. i. 47. — Willkomm, *Forst. Fl.* 242. — Watson & Coulter, *Gray's Man.* ed. 6, 491. — Mayr, *Wald. Nordam.* 211, t. 8, f. — Beissner, *Handb. Nadelh.* 246. — Masters, *Jour. R. Hort. Soc.* xiv. 238. — Hansen, *Jour. R. Hort. Soc.* xiv. 387 (*Pinetum Danicum*). — Koehne, *Deutsche Dendr.* 38. — Britton & Brown, *Ill. Fl.* i. 51, f. 111.

Pinus sylvestris, β **Norvegica**, Castiglioni, *Viag. negli Stati Uniti*, ii. 313 (1790).

Pinus rubra, Michaux f. *Hist. Arb. Am.* i. 45, t. 1 (not Miller) (1810). — De Chambray, *Traité Arb. Rés. Conif.* 344. — Gihoul, *Arb. Rés.* 27. — Provancher, *Fl. Canadienne*, ii. 554. — Carrière, *Traité Conif.* 401. — Sénéclauze, *Conif.* 141.

Pinus Laricio γ, Spach, *Hist. Vég.* xi. 385 (1842).

A tree, usually seventy or eighty feet high, with a tall straight trunk two or three feet in diameter, but occasionally attaining a height of one hundred and fifty feet, with a trunk five feet through, and stout spreading more or less pendulous branches which in youth clothe the stem to the ground, forming a broad irregular pyramid in old age becoming an open round-topped picturesque head. The bark of the trunk is from three quarters of an inch to an inch and a quarter in thickness and is slightly divided by shallow fissures into broad flat ridges covered with thin loose light reddish brown scales. The branchlets, which are stout and glabrous, are light orange-color when they first appear, darker orange in their first winter, brown tinged with purple during their second and third years, and later scaly and light reddish brown. The winter branch-buds are ovate, acute, from one half to three quarters of an inch long and about a quarter of an inch broad, and are covered with lanceolate loosely imbricated thin pale chestnut-brown scales, white, scarious and fringed on the margins, their firm dark bases being persistent on the branches for several years after the disappearance of the leaves, which fall during their fourth and fifth seasons. The leaves are borne in clusters of two, with close firm persistent sheaths half an inch long and at first pale chestnut-brown, and scarious above, but soon becoming dark purple-brown, and are slender, soft and flexible, serrulate, acute with short callous tips, dark green and lustrous, and five or six inches long; they are obscurely marked on the ventral faces with bands of minute stomata, and contain two fibro-vascular bundles and numerous peripheral and parenchymatous resin ducts surrounded by small strengthening cells.[1] The staminate flowers are produced in dense spikes about an inch long, and are oblong and from one half to three quarters of an inch in length, with dark purple anthers terminating in denticulate orbicular crests, and are surrounded by involucres of six ovate acute bracts which are deciduous by articulations above their base before

[1] Coulter & Rose, *Bot. Gazette*, xi. 305.

the anthers open. The pistillate flowers are terminal, subglobose, and about a quarter of an inch long, with broadly ovate scarlet scales rounded and reflexed at the apex, and are raised on short stout peduncles covered by acute chestnut-brown bracts. During their first winter the cones are ovate, erect, about half an inch in length and a quarter of an inch in thickness, and light red-brown; they begin to grow in May and June with the appearance of the new leaves and soon become horizontal, and when fully grown, at midsummer, they are ovate-conical, subsessile, bright green, and from two inches to two inches and a quarter long, with thin slightly concave scales rounded at the apex, the apophyses, which are conspicuously transversely keeled and slightly thickened, terminating in narrow transverse four-sided dark chestnut-brown unarmed umbos; they ripen and shed their seeds early in the autumn, when the exposed portions become light chestnut-brown and lustrous and the remainder dark dull purple, and mostly fall during the following spring or summer, but sometimes stay on the branches until another winter. The seeds are oval, compressed, about an eighth of an inch long, dark chestnut-brown and more or less mottled, with a thin crustaceous coat and from six to eight cotyledons; their wings are broadest below the middle, oblique at the apex, thin, light brown, three quarters of an inch in length and from one quarter to one third of an inch in breadth.

Pinus resinosa, the only American representative of a peculiar Old World group of Pine-trees of which *Pinus sylvestris* is the best known, grows on light sandy loam or dry rocky ridges, usually forming groves rarely more than a few hundred acres in extent scattered through forests of other Pines and of deciduous-leaved trees. It is distributed from Nova Scotia, where it abounds on the broad sandy plains near Kingston, and New Brunswick, where it is common, to the upper valley of the Patapedia River in eastern Quebec and to Lake St. John in latitude 48° north,,and westward through Quebec and central Ontario, where it is widely dispersed over sandy plains, to the shores of the Lake of the Woods and the valley of the Winnipeg River, being comparatively rare and growing only in small isolated groves west of central Ontario;[1] it is common in northern New England and New York, and ranges southward with small scattered colonies to eastern Massachusetts, where there are isolated groves in Boxford, Essex County,[2] and in Chestnut Hill, Middlesex County, with occasional trees in the neighboring towns, to the mountains of Pennsylvania, and to central Michigan, Wisconsin, and Minnesota, being most abundant and growing to its largest size in the northern parts of these three states, and producing here on dry gravelly ridges harder and stronger timber than any other tree of the region.[3]

The wood of *Pinus resinosa* is light, hard, and rather close-grained; it is pale red, with thin yellow or often nearly white sapwood, and contains broad dark-colored very resinous bands of small summer cells, few resin passages, and many thin inconspicuous medullary rays. The specific gravity of the absolutely dry wood is 0.4854, a cubic foot weighing 30.25 pounds. It is largely used in the construction of bridges and buildings, and for piles, masts, and spars, and is exported from Canada to Great Britain in considerable quantities.[4] The bark contains enough tannin to make it commercially valuable, and formerly it was occasionally used for tanning leather.[5]

The earliest description of *Pinus resinosa* was published by Duhamel[6] in 1755, and it was cultivated in England the following year.[7] In cultivation the Red Pine grows very rapidly, and its hardiness, its picturesque habit, and its long dark green leaves, make it the most desirable of all the Pitch Pines which flourish in the northern states for the decoration of their parks.[8]

[1] Brunet, *Cat. Vég. Lig. Can.* 56. — Bell, *Geolog. Rep. Can.* 1879–80, 50°. — Macoun, *Cat. Can. Pl.* 465.

[2] John Robinson, *Bull. Essex Institute*, xi. 103 (*Woody Plants of Essex County, Massachusetts*).

[3] Ayres, *Garden and Forest*, i. 106.

[4] Laslett, *Timber and Timber-Trees*, ed. 2, 350.

[5] Kalm, *Travels*, English ed. iii. 218. — Bastin & Trimble, *Am. Jour. Pharm.* xvi. 321, f. 28, 29.

[6] *Pinus Canadensis bifolia, conis mediis ovatis*, Pin Rouge de Canada, *Traité des Arbres*, ii. 125.

[7] Loudon, *Arb. Brit.* iv. 2210, f. 2094–2097.

[8] Sargent, *Rep. Sec. Board Agric. Mass.* xxv. 267.

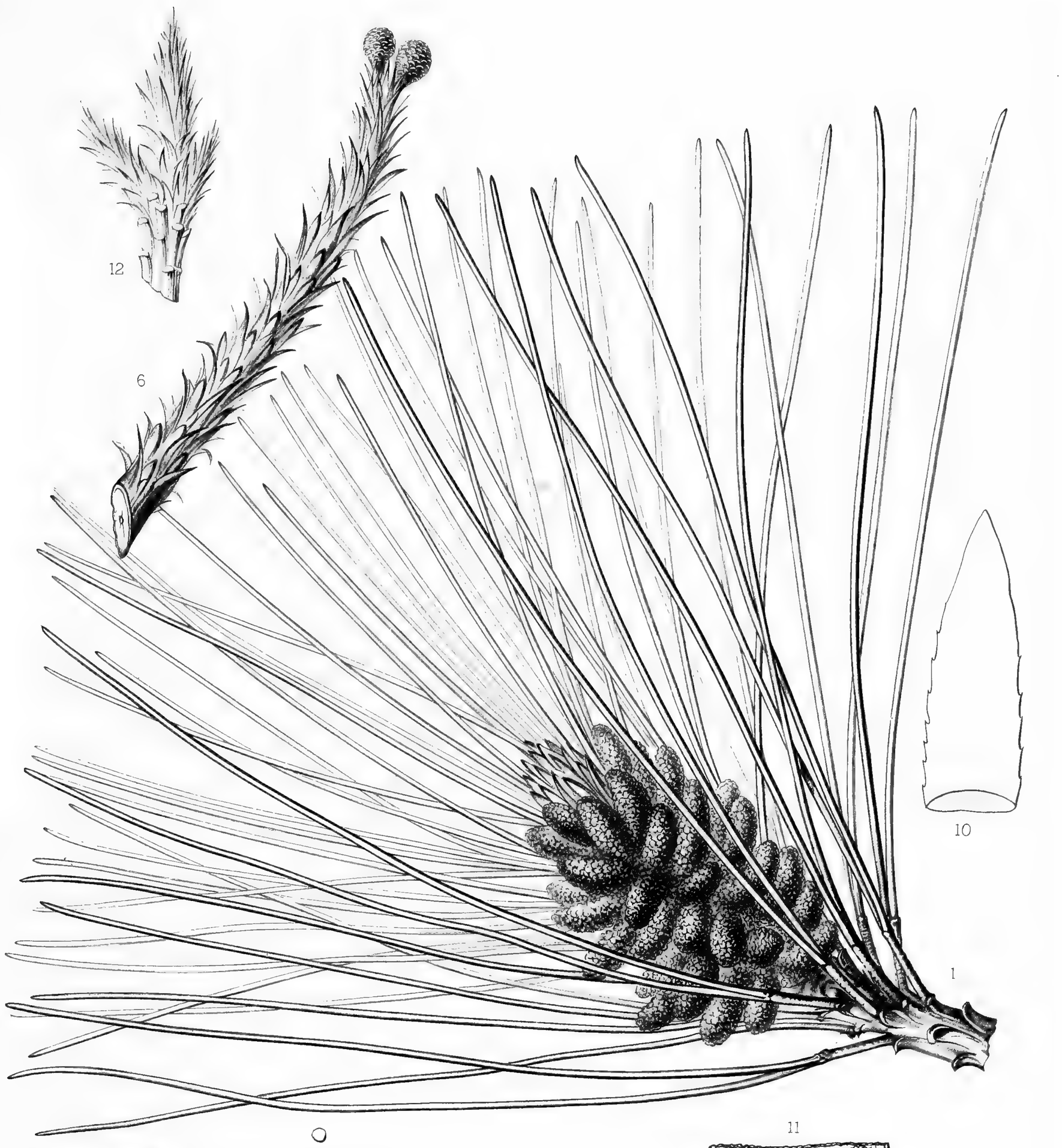
EXPLANATION OF THE PLATES.

PLATE DLV. PINUS RESINOSA.

1. A branch with staminate flowers, natural size.
2. A staminate flower, enlarged.
3. Diagram of the involucre of the staminate flower.
4. An anther, side view, enlarged.
5. An anther, front view, enlarged.
6. A branch with pistillate flowers, natural size.
7. A pistillate flower, enlarged.
8. A bract of a scale of a pistillate flower, lower side, enlarged.
9. A scale of a pistillate flower, upper side, with its bract and ovules, enlarged.
10. Tip of a leaf, enlarged.
11. Cross section of a leaf, magnified fifteen diameters.
12. A cluster of winter branch-buds, natural size.

PLATE DLVI. PINUS RESINOSA.

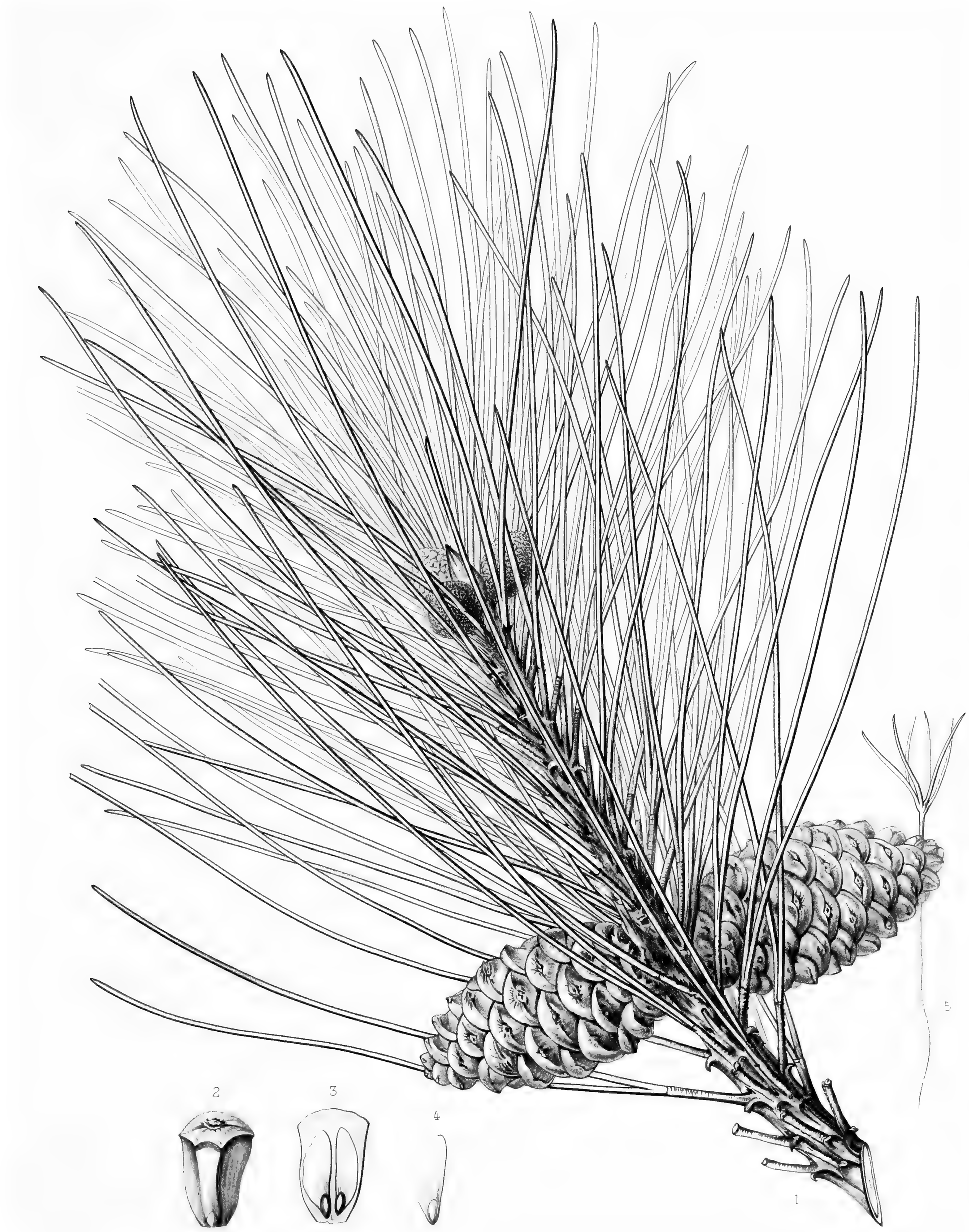
1. A fruiting branch, natural size.
2. A cone-scale, lower side, natural size.
3. A cone-scale, upper side, with its seeds, natural size.
4. A seed, natural size.
5. A seedling plant, natural size.



C.E.Faxon del. *Migneaux sc.*

PINUS RESINOSA, Ait.

A.Riocreux direx.t *Imp. J.Taneur, Paris.*



C.E. Faxon del. J. Migneaux sc.

PINUS RESINOSA, Ait.

A. Riocreux direx.t Imp. J. Taneur, Paris.

PINUS TORREYANA.

Soledad Pine.

LEAVES in 5-leaved clusters, stout, from 9 to 13 inches in length. Cones broadly ovate, from 4 to 6 inches long, their scales much thickened into broad straight or reflexed umbos terminating in minute spines.

Pinus Torreyana, Torrey, *Bot. Mex. Bound. Surv.* 210, t. 58, 59 (1859). — Carrière, *Traité Conif.* 326. — Gordon, *Pinetum*, 241. — Courtin, *Fam. Conif.* 75. — Henkel & Hochstetter, *Syn. Nadelh.* 117. — Bolander, *Proc. Cal. Acad.* iii. 318. — Hoopes, *Evergreens*, 150. — Sénéclauze, *Conif.* 122. — Engelmann, *Trans. St. Louis Acad.* iv. 181; *Brewer & Watson Bot. Cal.* ii. 125. — Veitch, *Man. Conif.* 173. — Sargent, *Forest Trees N. Am. 10th Census U. S.* ix. 192. — Parry, *Proc. San Diego Nat. Hist. Soc.* i. 37. — Lemmon, *Rep. California State Board Forestry*, ii. 75, 106, t. (*Pines of the Pacific Slope*); *West-American Cone-Bearers*, 38. — Steele, *Proc. Am. Pharm. Assoc.* 1887, 242 (*The Pines of California*). — Mayr, *Wald. Nordam.* 275, t. 7, f. — Beissner, *Handb. Nadelh.* 256. — Masters, *Jour. R. Hort. Soc.* xiv. 241. — Hansen, *Jour. R. Hort. Soc.* xiv. 399 (*Pinetum Danicum*). — Koehne, *Deutsche Dendr.* 34.

Pinus lophosperma, Lindley, *Gard. Chron.* 1860, 46. — Gordon, *Pinetum*, Suppl. 69. — Henkel & Hochstetter, *Syn. Nadelh.* 112. — (Nelson) Senilis, *Pinaceæ*, 117. — Parlatore, *De Candolle Prodr.* xvi. pt. ii. 391.

A tree, usually thirty or forty feet in height, with a short trunk about a foot in thickness, and stout spreading somewhat ascending branches, but occasionally sixty feet tall, with a long straight slightly tapering stem two and a half feet in diameter, and a comparatively narrow round-topped head; or sometimes, when fully exposed to ocean gales, semiprostrate with long contorted branches. The bark of the trunk is from three quarters of an inch to an inch in thickness, and deeply and irregularly divided into broad flat ridges covered by large thin closely appressed light red-brown scales. The branchlets, when they first appear, are from three quarters of an inch to an inch thick and light green; in their second year they are light purple and covered with a metallic bloom which does not disappear until the following season, when they begin to darken, and finally become almost black. The winter branch-buds are cylindrical, and abruptly contracted and acuminate at the apex, the terminal bud being an inch long and a third of an inch thick, or rather more than twice as large as the lateral buds; their outer scales are narrow and more or less tinged with purple; those of the inner ranks are broader, pale chestnut-brown, white and coarsely fringed on the margins, and soon become reflexed, roughening with their enlarged thickened bases the branches, from which they do not entirely disappear for several years. The pale chestnut-brown lustrous scales of the leaf-bud, scarious and fringed on the margins, continue to inclose the lengthening leaves until they are sometimes two inches long, and form a loose sheath, from which the upper part soon wears away, leaving the base, which is from three quarters of an inch to an inch in length, close and firm, dark brown or finally nearly black, and persistent. The leaves, which make great tufts at the ends of the branches, are borne in clusters of five and are acute with short callous tips, sharply serrate, from eight to thirteen inches long, about one sixteenth of an inch broad, and dark green; they contain two fibro-vascular bundles, usually three parenchymatous resin passages surrounded by strengthening cells, which also occur under the epidermis in from three to five layers, and are marked on their three faces with many rows of deeply set stomata.[1] The flowers appear from January to March, the staminate in short dense heads, the pistillate subterminal in pairs on stout peduncles an inch in length and covered by broadly ovate acute chestnut-brown bracts thin and scarious on the margins. The staminate flowers are cylindrical,

[1] Coulter & Rose, *Bot. Gazette*, xi. 306.

from two to two and a half inches long and about a third of an inch thick, with yellow anthers terminating in prominent denticulate crests, and are surrounded by involucres of fourteen broadly ovate acute chestnut-brown bracts. The pistillate flowers are oblong-oval, three quarters of an inch in length and about half an inch in width, with broadly ovate scales gradually narrowed into short points. The young cones grow slowly and remain erect during their first season, and at the end of the first year they are subglobose and about half an inch thick; they enlarge more rapidly during their second year, and when two years old they are ovate, from two and a half to three inches long, and dark chestnut-brown, with thickened pointed incurved light red-brown scales, and are raised on stout peduncles perpendicular to the branch and from an inch to an inch and a half in length; and at the end of the next season, when they are fully grown and open and discharge most of their seeds, they are broadly ovate, spreading or deflexed on stout peduncles, from four to six inches long, from three and a half to nearly five inches broad, and chocolate brown, with thick cone-scales almost an inch wide and short-pointed at the apex, the exposed portions being conspicuously four-angled and much thickened into central knobs terminating in short stout straight or elongated and reflexed umbos tipped by minute spines. The seeds are oval, more or less angled, from three quarters of an inch to nearly an inch in length, dull brown and mottled on the lower side and light yellow-brown on the upper side, with a hard shell about a sixteenth of an inch thick, sweet oily albumen, and an embryo with thirteen or fourteen cotyledons; they are nearly inclosed by the much thickened inner rim of the dark brown wings which extend beyond them from one third to nearly one half of an inch; during their fourth season the cones, which still contain some of the seeds, usually fall, generally leaving a few of their undeveloped scales on the peduncle attached to the branch.

Pinus Torreyana, which is the least widely distributed Pine-tree of the United States, grows in southern California near the mouth of the Soledad River, where it is scattered along the coast for a distance of eight miles, ranging inland only about a mile and a half,[1] and on the island of Santa Rosa, one of the Santa Barbara group.[2]

The wood of *Pinus Torreyana* is light, soft, not strong, brittle, and coarse-grained; it is light red, with thick yellow or nearly white sapwood, and contains broad conspicuous resinous bands of small summer cells, small resin passages, and numerous obscure medullary rays. The specific gravity of the absolutely dry wood is 0.4875, a cubic foot weighing 30.41 pounds. It is sometimes used for fuel. The large edible seeds are gathered in considerable quantities and eaten raw or roasted.[3]

Pinus Torreyana was first made known to science in 1850 by Dr. C. C. Parry, who named it for Dr. John Torrey.[4] It was introduced into European gardens many years ago; but little is known of its value as an ornamental plant.

[1] The most northern specimen of *Pinus Torreyana* on the mainland is isolated on a high mesa about a mile and a half from the coast and three miles to the north and a little to the east of the post-office of Del Mar. The most northerly grove is on the south bank of the San Diequito River, a mile north of Del Mar, where there are several fine trees, the tallest being about sixty feet high. From this point southward, and never more than a mile from the ocean, stand groups of all sizes and ages on the borders of the broken mesa, and on the sides of deep ravines or washes extending down from it to the shore, the largest trees growing on rocky slopes slightly protected from the sea breezes. From the San Diequito to the mouth of the Soledad there are between two and three hundred trees. South of the Soledad, upon high ground, sometimes several hundred feet above the level of the ocean, occur the largest groups, often of two or three hundred trees, stretching along the sides of ravines between high points jutting to the ocean, the most southerly station being five miles south of Point Pinos, where there are about a dozen trees (Belle S. Angier *in litt.*). Although now so restricted in its distribution, the number of seedlings which are constantly springing up near the older groves show that *Pinus Torreyana* is unimpaired in vitality and likely to survive in the well protected ravines into which it has probably been driven by a gradual change of climate or by fires on the dry mesas.

[2] In June, 1888, Mr. T. S. Brandegee found a grove of about one hundred trees on a bluff five hundred feet above the sea at the east end of Santa Rosa Island. The trees of all sizes up to a height of thirty feet were in perfect health, and the numerous seedlings showed the vitality of the species at this place. (See Brandegee, *Rep. California State Board Forestry*, ii. 111.)

[3] Palmer, *Am. Nat.* xii. 594.

[4] John Torrey (August 15, 1796–March 10, 1873) was born and educated in New York. He learned in early life the rudiments of botany from Amos Eaton, and studied mineralogy and chemistry; in 1815 he began the study of medicine, in 1818 obtaining a medical degree from the College of Physicians and Surgeons of New York, and engaged at once in the practice of medicine in his native city. In 1817 he contributed to the Lyceum of Natural History a catalogue of the plants growing in the neighborhood of New York;

and in 1824, when he published the first and only part of his *Flora of the Northern and Middle Sections of the United States*, Dr. Torrey was chosen professor of chemistry, mineralogy, and geology in the United States Military Academy at West Point, exchanging this position three years later for the chair of chemistry and botany in the College of Physicians and Surgeons of New York, which he filled until 1857, when he resigned it to become United States assayer at New York. As state botanist of New York, Dr. Torrey made a botanical survey of the state, publishing the results in two illustrated volumes in 1843 ; and beginning in 1823 with his account of the plants collected by Dr. James in the Rocky Mountains, he was actively engaged until nearly the end of his life in studying and making known the plants collected by the numerous government expeditions sent to explore the then unknown wilds of western North America. His most important work, *The Flora of North America*, undertaken in collaboration with Asa Gray, was only half completed, the first volume appearing in two parts in 1838–40, and the second in 1841–43. His herbarium, rich in the type-specimens of all his species and in all the early collections made in the west, and his botanical library, were given by him several years before his death to Columbia College, with which his Medical School had been united and in which he became professor emeritus.

John Torrey was one of the wisest, most clear-sighted, and industrious systematic botanists America has produced, and his name will never be forgotten by students of American plants, many of which he first made known to science.

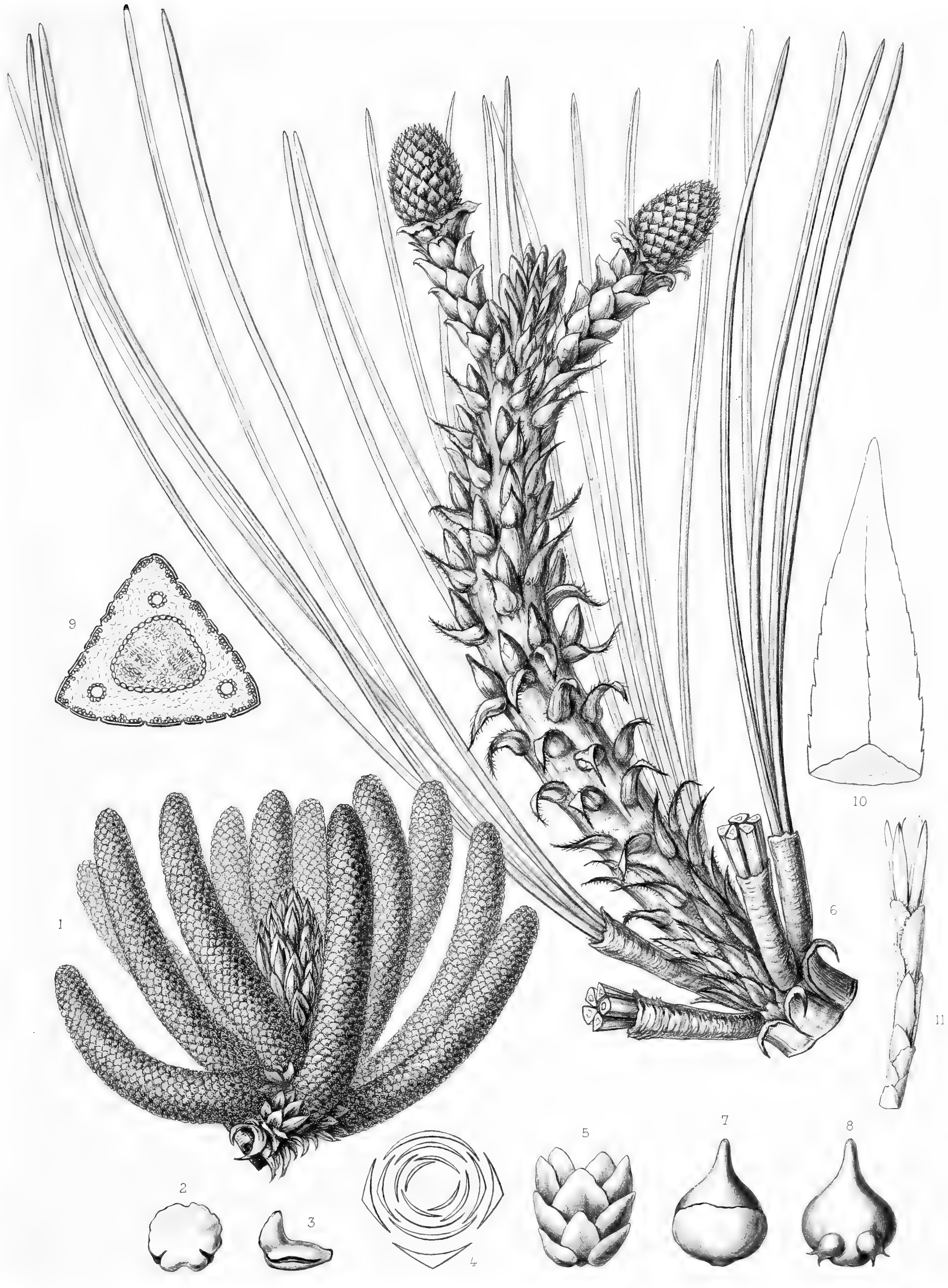
EXPLANATION OF THE PLATES.

PLATE DLVII. PINUS TORREYANA.

1. A cluster of staminate flowers, natural size.
2. An anther, front view, enlarged.
3. An anther, side view, enlarged.
4. Diagram of the involucre of the staminate flower.
5. An involucre of a staminate flower, enlarged.
6. A branch with pistillate flowers, natural size.
7. A scale of a pistillate flower, lower side, with its bract, enlarged.
8. A scale of a pistillate flower, upper side, with its ovules, enlarged.
9. Cross section of a leaf, magnified fifteen diameters.
10. Tip of a leaf, enlarged.
11. A cluster of young leaves, with its sheath, natural size.

PLATE DLVIII. PINUS TORREYANA.

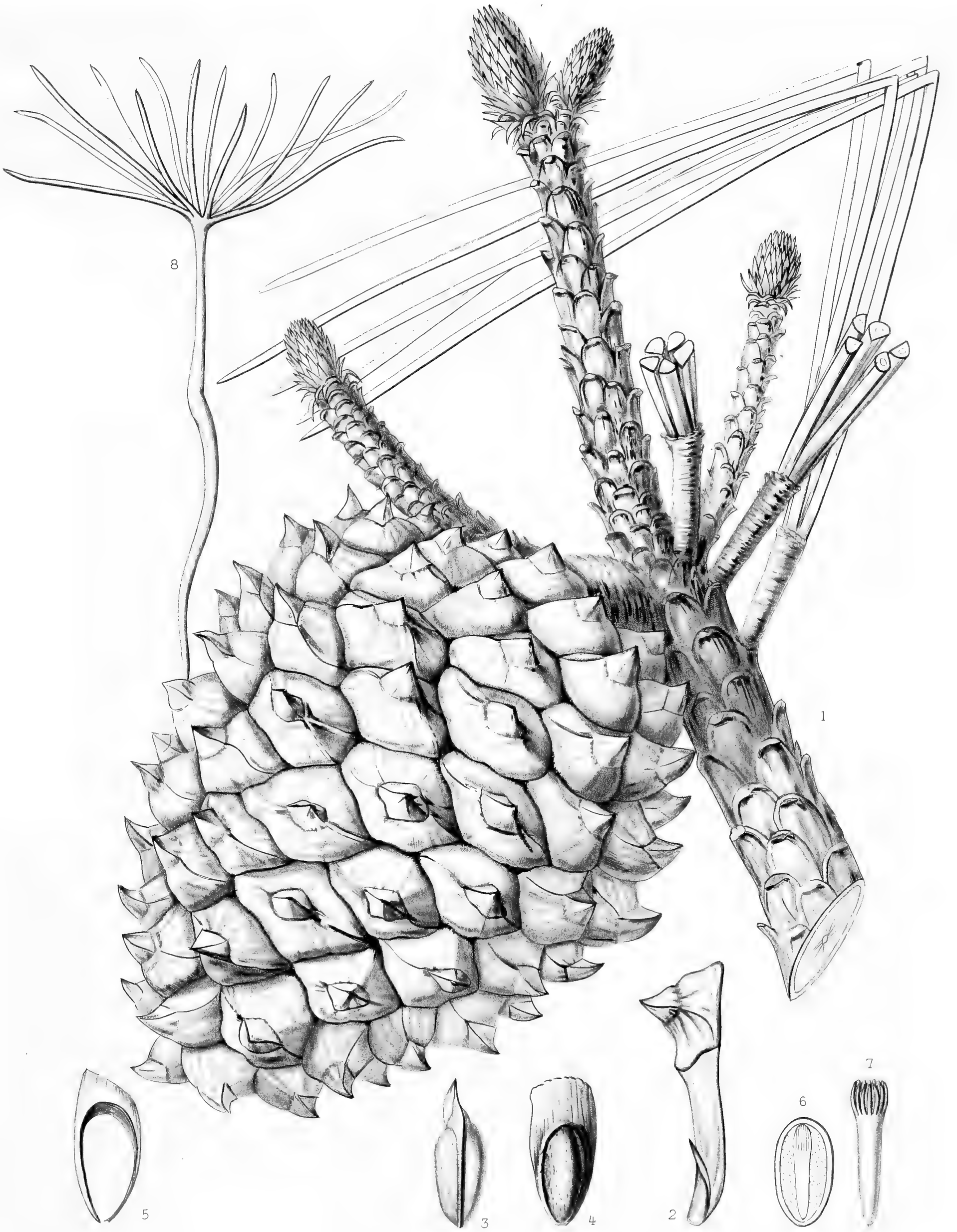
1. A fruiting branch, natural size.
2. A cone-scale, side view, natural size.
3. A seed with its wing, side view, natural size.
4. A seed with its wing, natural size.
5. A seed-wing, natural size.
6. Vertical section of a seed, natural size.
7. An embryo, enlarged.
8. A seedling plant, natural size.



C. E. Faxon del. *Rapine sc.*

PINUS TORREYANA, Torr.

A. Riocreux direx.^b *Imp. J. Taneur, Paris.*



C.E. Faxon del. Himely sc.

PINUS TORREYANA, Torr.

A. Riocreux direx.t Imp. J. Taneur, Paris.

PINUS ARIZONICA.

Yellow Pine.

LEAVES in 5-leaved clusters, stout, rigid, from 5 to 7 inches in length. Cones oval, from 2 to $2\frac{1}{2}$ inches long, their scales armed with slender recurved spines.

Pinus Arizonica, Engelmann, *Rothrock Wheeler's Rep.* vi. 260 (1878); *Trans. St. Louis Acad.* iv. 181; *Bot. Gazette*, vii. 4. — Hemsley, *Bot. Biol. Am. Cent.* iii. 186. — Sargent, *Forest Trees N. Am. 10th Census U. S.* ix. 192. — Mayr, *Wald. Nordam.* 239, t. 8, f. — Beissner, *Handb. Nadelh.* 260. — Masters, *Jour. R. Hort. Soc.* xiv. 225. — Koehne, *Deutsche Dendr.* 34. — Lemmon, *West-American Cone-Bearers*, 35.

A tree, from eighty to one hundred feet in height, with a tall straight massive trunk from three to four feet in diameter, and stout spreading branches forming an irregular open round-topped or narrow pyramidal head. The bark on young trunks is dark brown or almost black and deeply furrowed, and on fully grown trees it is from an inch and a half to two inches in thickness and divided into large unequally shaped plates separating on the surface into thin closely appressed light cinnamon-red scales. The branchlets are stout and dark orange-brown when they first appear, growing lighter in their second and third years, and then dark gray-brown. The branch-buds are ovate, acute, nearly half an inch long, and covered by loosely imbricated dark chestnut-brown scales with pale fringed margins, which continue for many years to roughen the branches with their thickened bases. The sheaths of the leaf-clusters, which at first are loose and bright chestnut-brown and from three quarters of an inch to an inch in length, soon become thick and firm, pale brown below, silvery above, and about half an inch long by the falling of the inner bud-scales, and are persistent. The leaves are borne in clusters of five and are stout, rigid, acute with short callous tips, closely serrulate, dark green, stomatiferous on their three faces, and from five to seven inches in length; they contain two fibro-vascular bundles and three parenchymatous resin passages, one in each of the angles, surrounded by strengthening cells, which also occur under the epidermis mostly in a single layer; they form dense tufts at the ends of the branches and appear to fall during their third year. The staminate flowers are produced in short compact spikes and are oval and from three quarters of an inch to an inch in length and about a quarter of an inch thick, with dark purple anthers terminating in orbicular denticulate crests, and are surrounded by an involucre of about twelve broadly ovate acute firm dark chestnut-brown lustrous bracts. The pistillate flowers are subterminal and usually in pairs on stout peduncles covered by ovate acute chestnut-brown bracts, and are about one third of an inch in length, with long-pointed dark purple reflexed scales. The cones remain erect and do not enlarge much during their first season, but when the flowers open the following spring they are horizontal, an inch and a half long and nearly an inch wide, with prominent strongly incurved tips to their scales; when fully grown in the autumn they are oval, from two to two and a half inches long and an inch and a half wide, with thin slightly concave scales rounded or pointed at the apex, the apophyses being transversely keeled and much thickened into central knobs terminated by stout umbos armed with slender recurved spines, and much recurved on the small lower scales; when the cones are open in the autumn the exposed portions of the scales are light red-brown and lustrous and the remainder dull red-brown on the upper side and dark purple on the lower. The seeds are an eighth of an inch long, full and rounded below, slightly compressed toward the apex, with a thick coat produced above into a narrow margin; their wings are broadest above the middle, about a third of an inch long, nearly a quarter of an inch wide, thin and light chestnut-brown.

In the United States *Pinus Arizonica* inhabits the cool high slopes and the sides of cañons of the

Santa Catalina, Rincon, Santa Rita, Huachuca, and Chiricahua Mountains of southern Arizona at altitudes between six and eight thousand feet above the level of the sea, forming a considerable part of their forests and on the Rincon Mountains a nearly pure forest some twenty-five square miles in area.[1] On the mountains of Sonora and Chihuahua it is more abundant and grows to its largest size, ranging through three thousand feet of elevation over the Cordilleras of Chihuahua from the cañons and valleys at their base to the highest summits, forming forests of great extent, and filling the place of the more northern *Pinus ponderosa* as a widely distributed, abundant, and valuable timber-tree.[2]

The wood of *Pinus Arizonica* produced on the Santa Rita Mountains in Arizona is light, soft, not strong, rather brittle, and close-grained; it is light red or often yellow, with thick lighter yellow or white sapwood, and contains broad very resinous conspicuous bands of small summer cells, numerous large resin passages, and thin obscure medullary rays.[3] The specific gravity of the absolutely dry wood is 0.5038, a cubic foot weighing 31.40 pounds. In Arizona it is occasionally manufactured into lumber, and in Mexico is often largely used, although it is difficult to obtain from the high and often inaccessible mountain slopes which are the home of this tree.

Pinus Arizonica was discovered by Professor John T. Rothrock[4] in 1874 on the Santa Rita Mountains of Arizona.

[1] See Toumey, *Garden and Forest*, x. 153.

Pinus Arizonica probably also grows on some of the mountain ranges of southeastern New Mexico.

[2] See C. G. Pringle, *Garden and Forest*, i. 430.

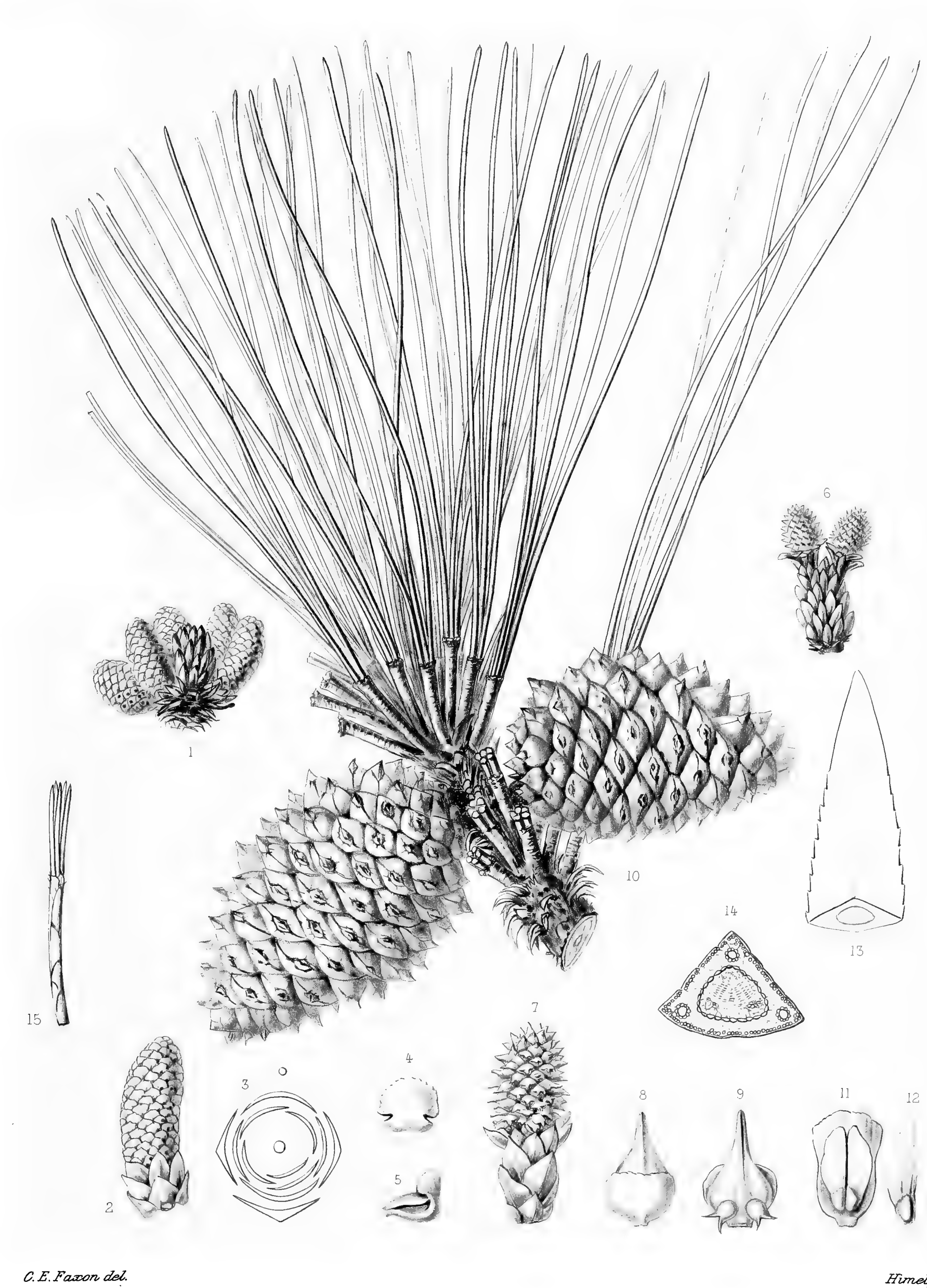
[3] *Pinus Arizonica* after its first few years grows slowly. The log specimen in the Jesup Collection of North American Woods in the American Museum of Natural History, New York, cut on the Santa Rita Mountains, is twenty-four inches in diameter inside the bark and one hundred and twenty-nine years of age, the sapwood being eight and five eighths inches thick and one hundred and two years old.

[4] See viii. 92.

EXPLANATION OF THE PLATE.

PLATE DLIX. PINUS ARIZONICA.

1. A cluster of staminate flowers, natural size.
2. A staminate flower, enlarged.
3. Diagram of the involucre of the staminate flower.
4. An anther, front view, enlarged.
5. An anther, side view, enlarged.
6. Tip of a branch with pistillate flowers, natural size.
7. A pistillate flower, enlarged.
8. A scale of a pistillate flower, lower side, with its bract, enlarged.
9. A scale of a pistillate flower, upper side, with its ovules and bract, enlarged.
10. A fruiting branch, natural size.
11. A cone-scale, upper side, with its seeds, natural size.
12. A seed, natural size.
13. Tip of a leaf, enlarged.
14. Cross section of a leaf, magnified fifteen diameters.
15. A cluster of young leaves with its sheath, natural size.



C. E. Faxon del. Himely sc.

PINUS ARIZONICA, Engelm.

A. Riocreux direx.t Imp. J. Taneur, Paris.

PINUS PONDEROSA.

Yellow Pine. Bull Pine.

LEAVES in 3 or in 2 and 3-leaved clusters, stout, rigid, from 3 to 15 inches in length. Cones oval, from 3 to 6 inches long, separating at maturity from their lower scales persistent on the peduncle.

Pinus ponderosa, Lawson & Son, *Agric. Man.* 355 (1836); *List No. 10, Abietineæ*, 33. — Loudon, *Arb. Brit.* iv. 2243, f. 2132–2136. — Forbes, *Pinetum Woburn.* 44, t. 15. — Antoine, *Conif.* 28, t. 8, f. 1. — Link, *Linnæa*, xv. 506. — Nuttall, *Sylva*, iii. 114. — Spach, *Hist. Vég.* xi. 389. — Endlicher, *Syn. Conif.* 163. — Knight, *Syn. Conif.* 30. — Lindley & Gordon, *Jour. Hort. Soc. Lond.* v. 217. — Dietrich, *Syn.* v. 399. — Carrière, *Traité Conif.* 340. — Gordon, *Pinetum*, 205. — Courtin, *Fam. Conif.* 79. — Newberry, *Pacific R. R. Rep.* vi. pt. iii. 36. — Cooper, *Pacific R. R. Rep.* xii. pt. ii. 27, 68; *Am. Nat.* iii. 409. — Torrey, *Bot. Mex. Bound. Surv.* 209; *Ives' Rep.* pt. iv. 28. — Lyall, *Jour. Linn. Soc.* vii. 142. — Bolander, *Proc. Cal. Acad.* iii. 226, 317. — Henkel & Hochstetter, *Syn. Nadelh.* 71, 415. — (Nelson) Senilis, *Pinaceæ*, 125. — Hoopes, *Evergreens*, 117. — Sénéclauze, *Conif.* 128. — Parlatore, *De Candolle Prodr.* xvi. pt. ii. 395 (excl. syn. *Pinus Sinclairiana*). — K. Koch, *Dendr.* ii. pt. ii. 310. — Engelmann, *Rothrock Wheeler's Rep.* vi. 261; *Trans. St. Louis Acad.* iv. 181; *Brewer & Watson Bot. Cal.* ii. 125. — Kellogg, *Forest Trees of California*, 51. — Sargent, *Forest Trees N. Am. 10th Census U. S.* ix. 192. — Lauche, *Deutsche Dendr.* ed. 2, 110. — Schübeler, *Virid. Norveg.* i. 393. — Willkomm, *Forst. Fl.* 191. — Lemmon, *Rep. California State Board Forestry*, ii. 73, 97, t. (*Pines of the Pacific Slope*); *West-American Cone-Bearers*, 32. — Steele, *Proc. Am. Pharm. Assoc.* 1889, 237 (*The Pines of California*). — Mayr, *Wald. Nordam.* 308, f. 11, t. 7, f. — Masters, *Gard. Chron.* ser. 3, viii. 557, f. 110, 111, 114, 115; *Jour. R. Hort. Soc.* xiv. 237. — Beissner, *Handb. Nadelh.* 260, f. 61. — Hansen, *Jour. R. Hort. Soc.* xiv. 383 (*Pinetum Danicum*). — Hempel & Wilhelm, *Bäume und Sträucher*, i. 189, f. 111 A. — Merriam, *North American Fauna*, No. 7, 338 (*Death Valley Exped.* ii.). — Coville, *Contrib. U. S. Nat. Herb.* iv. 223 (*Bot. Death Valley Exped.*). — Koehne, *Deutsche Dendr.* 35.

Pinus resinosa, Hooker, *Fl. Bor.-Am.* ii. 161 (in part) (not Aiton) (1839).

Pinus Benthamiana, Hartweg, *Jour. Hort. Soc. Lond.* ii. 189 (1847); iii. 223. — Lawson & Son, *List No. 10, Abietineæ*, 30. — Gordon, *Jour. Hort. Soc. Lond.* iv. 212, t.; *Fl. des Serres*, vi. 85, f.; *Pinetum*, 188. — Courtin, *Syn. Conif.* 76. — Knight, *Syn. Conif.* 30. — Lindley & Gordon, *Jour. Hort. Soc. Lond.* v. 216. — Carrière, *Traité Conif.* 350. — A. Murray, *Edinburgh New Phil. Jour.* n. ser. i. 287, t. 8. — Henkel & Hochstetter, *Syn. Nadelh.* 84. — (Nelson) Senilis, *Pinaceæ*, 104. — Sénéclauze, *Conif.* 123.

Pinus brachyptera, Engelmann, *Wislizenus Memoir of a Tour to Northern Mexico* (*Senate Doc.* 1848), Bot. Appx. 89. — Lindley & Gordon, *Jour. Hort. Soc. Lond.* v. 216. — Carrière, *Rev. Hort.* 1854, 227; *Fl. des Serres*, ix. 201; *Traité Conif.* 356. — J. M. Bigelow, *Pacific R. R. Rep.* iv. pt. v. 18. — Gordon, *Pinetum*, 190. — Henkel & Hochstetter, *Syn. Nadelh.* 85. — (Nelson) Senilis, *Pinaceæ*, 105.

Pinus Beardsleyi, A. Murray, *Edinburgh New Phil. Jour.* n. ser. i. 286, t. 6 (1855). — Carrière, *Traité Conif.* 359. — Sénéclauze, *Conif.* 123. — Hansen, *Jour. R. Hort. Soc.* xiv. 351 (*Pinetum Danicum*).

Pinus Craigana, A. Murray, *Edinburgh New Phil. Jour.* n. ser. i. 288, t. 7 (1855).

Pinus Engelmanni, Torrey, *Pacific R. R. Rep.* iv. pt. v. 141 (not Carrière) (1856).

Pinus Parryana, Gordon, *Pinetum*, 202 (1858). — Henkel & Hochstetter, *Syn. Nadelh.* 88. — Carrière, *Traité Conif.* ed. 2, 446.

Pinus ponderosa, var. **Benthamiana**, Vasey, *Rep. Dept. Agric. U. S.* 1875, 178 (*Cat. Forest Trees U. S.*) (1876).

Pinus ponderosa, (a) **Benthamiana**, Lemmon, *Rep. California State Board Forestry*, ii. 73, 97 (*Pines of the Pacific Slope*) (1888); *West-American Cone-Bearers*, 33.

Pinus ponderosa, (c) **brachyptera**, Lemmon, *Rep. California State Board Forestry*, ii. 73, 98 (*Pines of the Pacific Slope*) (1888).

Pinus ponderosa, var. (a) **nigricans**, Lemmon, *West-American Cone-Bearers*, 33 (1895).

The typical form of this variable species when growing under the best conditions is a tree, usually from one hundred and fifty to two hundred feet in height, with a massive stem five or six feet in

diameter, or exceptionally two hundred and thirty feet tall, with a trunk eight feet in diameter,[1] short thick many-forked often pendulous branches[2] generally ascending at the ends and forming a narrow regular spire-like head which constitutes from one third to one half the height of the tree; or, when less favorably situated, producing a shorter trunk and stouter branches forming a broader and often round-topped head. During the first eighty or one hundred years of its life the bark of the trunk is broken into rounded ridges covered with small closely appressed scales, and is dark brown, nearly black, or light cinnamon-red; and on older trees it is from two to four inches thick and deeply and irregularly divided into plates sometimes four or five feet long and twelve or eighteen inches wide, and covered with thick bright cinnamon-red scales. The branchlets are stout and more or less fragrant when cut, with the pungent aromatic odor of orange-peel; when they first appear they are orange-color, but soon grow darker, frequently becoming nearly black at the end of two or three seasons, and are much roughened for several years by the thickened persistent bases of the ovate acute light chestnut-brown conspicuously fringed scales of the branch-buds, which are often half an inch long and soon become reflexed, those of the outer ranks being linear-lanceolate and dark or light red-brown. The branch-buds are ovate, gradually narrowed and acute at the apex, the terminal bud being from one half to three quarters of an inch long and frequently twice as large as the lateral buds. The leaves form great tufts at the ends of the naked branches, and are borne in clusters of three in sheaths which are at first loose, pale chestnut-brown, and from three quarters of an inch to an inch in length, but, soon losing the inner bud-scales, become about a quarter of an inch long and thick, dark brown or nearly black, and fall with the leaves, mostly during their third season; they are acute with sharp-pointed callous tips, finely serrate, dark yellow green, stomatiferous on the three faces, and from five to eleven inches in length; they contain two fibro-vascular bundles and usually two or sometimes as many as five parenchymatous resin ducts surrounded by strengthening cells, which also occur in from one to three layers under the epidermis.[3] The pistillate flowers are borne in short crowded spikes, and are cylindrical, flexuous, from an inch and a half to two inches long and about half an inch thick, with yellow anthers terminating in conspicuous semiorbicular obscurely denticulate crests, and are surrounded by involucres of ten or twelve broadly ovate light chestnut-brown bracts scarious on the margins and rounded at the apex. The pistillate flowers are subterminal, clustered or in pairs, oval, dark red, and about one third of an inch long and one quarter of an inch broad, with ovate scales gradually narrowed into elongated slender tips and conspicuous orbicular bracts fimbriate on the margins. The young cones are erect in their first summer, and during the winter are from an inch to an inch and a quarter long and about three quarters of an inch thick, with light red-brown ovate scales produced into long or short slender incurved or straight awn-like spines; when fully grown, at midsummer, the cones are oval, horizontal, or slightly declining, subsessile or short-stalked, from three to six inches long and from an inch and a half to two inches broad, often in clusters of from three to five, and bright green or purple,[4] with

[1] The largest specimen measured by Muir on the California Sierras was two hundred and twenty feet high, with a trunk eight feet in diameter; other specimens measured by him in California were one hundred and eighty feet high, with a trunk three feet ten inches in diameter, and three hundred and eighty years old; one hundred and seventy-five feet high, with a trunk five feet one inch in diameter, and two hundred and sixty years old; a trunk three feet six inches in diameter, and two hundred and thirty-five years old; a trunk two feet in diameter, and two hundred and thirty-one years old; a trunk three feet four inches in diameter, and one hundred and eight years old; and a trunk three feet three inches in diameter, and one hundred years old. The log specimen in the Jesup Collection of North American Woods in the American Museum of Natural History, New York, cut on the western slope of the northern Sierra Nevada, is forty-seven and three quarters inches in diameter inside the bark, and three hundred and seventy-nine years old, the sapwood being eight and a half inches thick and two hundred and eleven years old.

[2] A seedling raised in the Knaphill Nursery, England, and planted by Mr. Henry Winthrop Sargent in his garden at Fishkill-on-the-Hudson, New York, in 1851, when a few inches high, grew into a tree with long drooping branches, forming a narrow column which in forty years had attained a height of sixty feet, and become an object of beauty and interest before its ruin by fungal disease (H. W. Sargent, *Gard. Chron.* II. ser. x. 236, f. 42. — Sargent, *Garden and Forest*, i. 392, f. 62).

[3] Coulter & Rose, *Bot. Gazette*, xi. 306.

[4] The cones of what may be considered the typical form of *Pinus ponderosa* are usually green; but in the Bitter Root valley, in Montana, trees bearing all green cones and all purple cones are mixed together in about equal numbers, while on the plains north of Flathead Lake in Montana most of the trees bear purple cones.

thin narrow slightly concave scales usually rounded or sometimes pointed at the apex, the apophyses being transversely keeled and slightly or much thickened into central knobs terminating in compressed straight or recurved umbos armed with slender prickles; at maturity the exposed portion of the scales turns light reddish brown and becomes lustrous, and the remainder dull red-brown on the upper side and deep purple on the lower; after ripening the cones mostly fall during the first autumn and winter, usually leaving their lower scales attached to the peduncles.[1] The seeds are ovate, acute, compressed at the apex, full and rounded below, and about a quarter of an inch long, with a thin dark purple often more or less mottled coat produced above into a narrow rim; their wings are usually broadest below the middle, thin, pale brown, gradually narrowed at the oblique apex, from an inch to an inch and a quarter in length and about an inch in width; the cotyledons vary from six to nine in number.

Pinus ponderosa inhabits mountain slopes, dry valleys, and high mesas from northwestern Nebraska and western Texas to the shores of the Pacific Ocean, and from southern British Columbia to Lower California and northern Mexico. The typical form ranges from about latitude 51° north in the interior of British Columbia,[2] southward through western Montana and northern Idaho, and through Washington and Oregon, and along the slopes of the Sierra Nevada and the California coast ranges, growing in the interior on the arid soil of high valleys and on dry mountain slopes, and forming open forests often of great extent; in western British Columbia and in Washington and Oregon west of the Cascade Mountains it is usually found only on dry gravelly plains, or rarely in swamps, where it is always small and stunted, with rough nearly black bark; in California it attains its largest size on the basins of filled-up lakes on the western slopes of the Sierra Nevada, where it is common from an elevation of about two thousand feet above the sea nearly to the upper limits of tree-growth;[3] crossing the range through the lowest passes, it extends down to its eastern base and out on to the hot volcanic plains beyond, sweeping with a great forest northward into Oregon, where it extends from the eastern foothills of the Cascade Mountains north of the Klamath Lakes at an elevation of about two thousand five hundred feet above the sea eastward to the mountains east of Goose Lake, covering them, with the exception of their highest peaks, with large trees.[4]

In southern Oregon, where it is common and is the largest tree on the dry volcanic foothills of the Siskiyou Mountains near Waldo, a form occurs[5] with more pungently aromatic juices, stiffer and more

[1] This peculiarity of the breaking away of the cone of *Pinus ponderosa* from its lower scales seems common to nearly all individuals of its numerous forms; but during the summer of 1896 Professor J. W. Toumey found a single tree on the Chiricahua Mountains in Arizona, from which the small cones had all fallen without breaking. One of these cones is figured on plate dlxv. f. 3.

[2] G. M. Dawson, *Can. Nat.* n. ser. ix. 326. — Macoun, *Cat. Can. Pl.* 466.

[3] Muir, *The Mountains of California*, 162, f.

[4] C. Hart Merriam *in litt.*

[5] *Pinus ponderosa*, var. *Jeffreyi*, Vasey, *Rep. Dept. Agric. U. S.* 1875, 179 (*Cat. Forest Trees U. S.*) (1876). — Engelmann, *Trans. St. Louis Acad.* iv. 181; *Brewer & Watson Bot. Cal.* ii. 126.

Pinus Jeffreyi, A. Murray, *Rep. Oregon Exped.* ii. t. 1 (1853); *Edinburgh New Phil. Jour.* n. ser. xi. 224, t. 8, 9; *Trans. Bot. Soc. Edinburgh*, vi. 350, t. — Carrière, *Traité Conif.* 358. — Gordon, *Pinetum*, 198. — Henkel & Hochstetter, *Syn. Nadelh.* 87. — (Nelson) Senilis, *Pinaceæ*, 115. — Hoopes, *Evergreens*, 115. — Sénéclauze, *Conif.* 126. — Parlatore, *De Candolle Prodr.* xvi. pt. ii. 393. — Lawson, *Pinetum Brit.* i. 45, t. 6, f. 1–4. — K. Koch, *Dendr.* ii. pt. ii. 314. — Engelmann, *Bot. Gazette*, vii. 4. — Veitch, *Man. Conif.* 165. — Sargent, *Forest Trees N. Am. 10th Census U. S.* ix. 193. — Lauche, *Deutsche Dendr.* ed. 2, 111. — Hooker f. *Gard. Chron.* n. ser. xxii. 814, f. 141. — Schübeler, *Virid. Norveg.* i. 390. — Willkomm, *Forst. Fl.* 192. — Lemmon, *Rep. California State Board Forestry*, ii. 73, 99 (*Pines of the Pacific Slope*); *West-American Cone-Bearers*, 34, t. 5. — Steele, *Proc. Am. Pharm. Assoc.* 1889, 238 (*The Pines of California*). — Masters, *Gard. Chron.* ser. 3, v. 360, f. 65, 68; *Jour. R. Hort. Soc.* xiv. 231. — Mayr, *Wald. Nordam.* 327, f. 15, t. 7, f. — Beissner, *Handb. Nadelh.* 263, f. 62. — Hansen, *Jour. R. Hort. Soc.* xiv. 365 (*Pinetum Danicum*). — Hempel & Wilhelm, *Bäume und Sträucher*, i. 189, f. 111, B–D. — Merriam, *North American Fauna*, No. 7, 339 (*Death Valley Exped.* ii.). — Coville, *Contrib. U. S. Nat. Herb.* iv. 222 (*Bot. Death Valley Exped.*). — Koehne, *Deutsche Dendr.* 35.

Pinus deflexa, Torrey, *Bot. Mex. Bound. Surv.* 209, t. 56 (in part) (1859). — Henkel & Hochstetter, *l. c.* 416. — Carrière, *l. c.* ed. 2, 455. — Bolander, *Proc. Cal. Acad.* iii. 318. — Parlatore, *l. c.* 431. — A. Murray, *Gard. Chron.* n. ser. iii. 106. — Gordon, *l. c.* ed. 2, 289. — Beissner, *l. c.* — Hansen, *l. c.* 357.

Pinus Jeffreyi, var. *nigricans*, Lemmon, *Rep. California State Board Forestry*, ii. 74, 100, t. (*Pines of the Pacific Slope*) (1888). — Steele, *l. c.*

Pinus Jeffreyi, var. (b) *deflexa*, Lemmon, *l. c.* (1888); *West-American Cone-Bearers*, 35. — Steele, *l. c.*

Pinus Jeffreyi, var. (c) *montana*, Lemmon, *West-American Cone-Bearers*, 35 (1895).

In its extreme forms *Pinus Jeffreyi* is very distinct from any of

elastic leaves from four to nine inches in length and persistent on the glaucous stouter branches for from six to nine years, yellow-green staminate flowers, short-stalked usually purple cones from five to twelve inches in length, their scales armed with stout or slender prickles, usually hooked backward, and seeds often nearly half an inch long, with larger wings and from seven to eleven cotyledons. This tree forms a considerable forest on Scott Mountain in northern California, where it was discovered in 1850 by John Jeffrey, and occurs on Snow Mountain, one of the highest peaks of the Coast Range in Lake County;[1] it is abundant in the great forests of Yellow Pine which cover the slopes of the valley of the upper Pitt River, growing to a large size on the margins of arid volcanic table-lands and Artemisia-covered plains; it is the common form in the great yellow Pine forests which clothe the eastern slope of the central and southern Sierras, where it probably grows to its largest size, attaining a height of from one hundred to nearly two hundred feet, with a tall massive trunk from four to six feet in diameter covered with bright cinnamon-red bark deeply divided into large irregular plates; it is also common at high elevations on the western slope of the Sierras, where it is able to maintain a foothold on the most exposed and driest ridges and cliffs,[2] here being often almost reduced to a shrub with stout semi-prostrate branches, or, when sprung from seeds washed down by mountain torrents, attaining fair proportions in sheltered cañons at lower altitudes; it abounds, too, on the San Bernardino and San Jacinto Ranges up to elevations of eight thousand feet above the sea and on the Cuyamaca Mountains; and in northern Lower California it forms extensive forests on the San Rafael Mountains east of Todos Santos Bay at elevations between four and six thousand feet,[3] and finds its most southerly home on high dry slopes of Mt. San Pedro Martir, near the middle of the peninsula.[4]

A form[5] with nearly black furrowed bark or with bright cinnamon-red bark broken into large

the other forms of *Pinus ponderosa;* but the two are united by many intermediate varieties, which often make it impossible to distinguish the two trees as they grow together. Trees of such intermediate characters are abundant in the Pine forest on the head of Pitt River, near the shores of Lake Tahoe on the eastern slope of the Sierra Nevada, and on the San Bernardino and San Jacinto Mountains, where forests of trees occur which may be as well referred to one form as to the other.

[1] K. Brandegee, *Zoë*, iv. 176.

[2] *Garden and Forest*, iv. 457, f. 73.

[3] This is the *Pinus Jeffreyi*, var. *peninsularis*, of Lemmon (*Rep. California State Board Forestry*, ii. 74 [*Pines of the Pacific Slope*] [1888]; *West-American Cone-Bearers*, 35. — Steele, *Proc. Am. Pharm. Assoc.* 1889, 239 [*The Pines of California*]), who describes it as growing only on the loose débris of white granite, and attaining a height of from one hundred and fifty to two hundred feet, with a spire-like fusiform habit. "The bark is grayish or drab, thick, hard, deeply fissured. . . . Yearling cones very large, an inch to an inch and a half long, elliptical, and purple. Mature cones abundant, many years' crops lying under the trees, all large, broadly ovate, six to eight inches long, truncate at base, mahogany-colored, with prickles strongly deflexed" (Lemmon, *Rep. California State Board of Forestry, l. c.* 101. — Orcutt, *Garden and Forest*, v. 183, f. 28, 29).

[4] Brandegee, *Zoë*, iv. 201.

[5] *Pinus ponderosa*, var. *scopulorum*, Engelmann, *Brewer & Watson Bot. Cal.* ii. 126 (1880). — Coulter, *Man. Rocky Mt. Bot.* 432. — Lemmon, *l. c.* 73, 78; *West-American Cone-Bearers*, 34. — Watson & Coulter, *Gray Man.* ed. 6, 734. — Beissner, *Handb. Nadelh.* 263. — Masters, *Jour. R. Hort. Soc.* xiv. 238. — Hansen, *Jour. R. Hort. Soc.* xiv. 384 (*Pinetum Danicum*). — Merriam, *North American Fauna*, No. 7, 339 (*Death Valley Exped.* ii.). — Coville, *Contrib. U. S. Nat. Herb.* iv. 223 (*Bot. Death Valley Exped.*). — Britton & Brown, *Ill. Fl.* i. 51, f. 113.

Pinus resinosa, Torrey, *Am. Lyc. N. Y.* ii. 249 (not Aiton) (1820). — Winchell, *Ludlow Rep. Black Hills, Dakota*, 68.

Pinus macrophylla, Torrey, *Sitgreaves' Rep.* 173 (not Engelmann) (1853).

Pinus ponderosa, Engelmann, *Am. Jour. Sci.* ser. 2, xxxiv. 332 (not Douglas) (1862). — Watson, *King's Rep.* v. 331. — Porter & Coulter, *Fl. Colorado; Hayden's Surv. Misc. Pub.* No. 4, 129. — *Gard. Chron.* II. ser. ix. 796, f. 138. — Coulter, *Contrib. U. S. Nat. Herb.* ii. 554 (*Man. Pl. W. Texas*).

Pinus scopulorum, Lemmon, *Garden and Forest*, x. 183 (1897).

Pinus ponderosa, var. *scopulorum*, is a tree, usually from fifty to seventy-five feet in height, but under favorable conditions one hundred or one hundred and twenty-five feet tall, with a trunk two or three or rarely four feet in diameter, and stout branches which in youth form a broad open pyramid and in old age a round-topped picturesque head. The variations in the bark are best seen in northern New Mexico and Arizona, where among trees standing side by side, of the same size and probably of the same age, some have bright cinnamon-red bark broken into large plates, and others nearly black furrowed bark. On young trees of this variety the bark is usually dark and fissured, and in other parts of the country this form of bark may be found on half-grown individuals; but I have seen it on large trees only on the Colorado plateau; and here it should perhaps be considered a juvenile character, as the bark of the very largest trees is commonly cinnamon-red and broken into plates.

The Yellow Pine of Nebraska, Colorado, and Texas is certainly distinct in its habit, in the length of its leaves, which are often in clusters of two, and in the size of its cones, from the trees of the western slope of the California Sierra Nevada; but the two forms mingle and are often indistinguishable in the region west of the summits of the northern Rocky Mountains, and it is probably best to consider this Yellow Pine one of the numerous forms of the polymorphous and widely distributed *Pinus ponderosa*.

scaly plates, with rigid leaves in clusters of two or of three and from three to six inches in length, staminate flowers an inch long, and green cones two or three or rarely four inches in length, with thin scales armed with slender prickles hooked backward, is the Yellow Pine of Nebraska, where it is distributed from Long Pine Creek, a tributary of the Niobrara River a few miles east of the one hundredth meridian, through the western and northwestern parts of the state;[1] this is the most common tree of the mountain forests of the Black Hills of South Dakota; it occurs on several of the mountain ranges of Wyoming and of eastern Montana, and is the Yellow Pine of Colorado, where it is common between six and ten thousand feet above the sea, forming open stunted forests with the Nut Pine, the Juniper, and the Douglas Spruce;[2] and of the mountain ranges of eastern and southern Utah; it is also the Yellow Pine of western Texas, where it is common, and the most valuable timber-tree on several mountain ranges,[3] and of northern New Mexico and Arizona, forming on the Colorado plateau, at elevations from seven thousand to eight thousand two hundred feet, one of the most extensive Pine forests of the continent, here sometimes ascending to nearly nine thousand, and descending to four thousand five hundred feet above the sea-level.[4]

The Yellow Pine,[5] which often forms a large part of the forest on the mountains of southern Arizona, frequently differs from more northern forms of *Pinus ponderosa* in its much longer and broader leaves in clusters of three, which are sometimes fourteen or fifteen inches in length and one sixteenth of an inch wide, in the shape of its cones made more oblique by the greater development of the scales on their upper side, and in its mammillate projecting umbos armed with slender prickles. On the Chiricahua Mountains of southern Arizona a form[6] is common which appears to connect this tree with others of the species; its leaves are more slender, and usually from twelve to fourteen inches long, in clusters of three or rarely of four or five, and its cones vary from three to five inches in length, their somewhat thickened scales terminating in prominently elevated or, toward the base of the cones, in mammillate umbos armed with straight slender prickles.

Pinus ponderosa is the principal timber-tree of eastern Washington and Oregon, of western Montana, Idaho, and the Black Hills of South Dakota, and of western Texas, New Mexico, and Arizona. It produces heavy hard and strong but ultimately brittle comparatively fine-grained wood, which is not durable in contact with the soil; it is light red, with almost white sapwood, which is sometimes more than two hundred years old, but varies greatly on different individuals and in different parts of the country in the number of its layers of annual growth. It contains broad or narrow very

[1] In Nebraska the Yellow Pine extends from the border of Wyoming along Pine Ridge and the Niobrara River to the eastern boundary of Rock and Keya Paha Counties, and on the North Platte as far east as Deuel County. The remnants of its dead trunks in many cañons of Loup River and in Custer, Valley, Greely, and Lincoln Counties, show that it once ranged farther east, and covered a larger part of the state (Bessey, *Bull. Torrey Bot. Club*, xiv. 189; *Am. Nat.* xxi. 928; *Rep. Nebraska State Board Agric.* 1894, 100; *Garden and Forest*, viii. 102).

[2] Brandegee, *Bot. Gazette*, iii. 32.

[3] Havard, *Proc. U. S. Nat. Mus.* viii. 503.

[4] Merriam, *North American Fauna*, iii. 121.

[5] *Pinus ponderosa*, var. *Mayriana*.

Pinus latifolia, Sargent, *Garden and Forest*, ii. 496, f. 135 (not *Pinus sylvestris latifolia*, Gordon, nor *Pinus contorta*, var. *latifolia*, Engelmann) (1889). — Beissner, *Handb. Nadelh.* 259. — Masters, *Jour. R. Hort. Soc.* xiv. 232 (excl. syn. *Pinus latisquama*). — Koehne, *Deutsche Dendr.* 36. — Lemmon, *West-American Cone-Bearers*, 36.

Pinus Engelmanni, Lemmon, *Erythea*, i. 134 (not Torrey nor Carrière [1893]).

Pinus Mayriana, Sudworth, *Bull.* No. 14, *Forestry Div. U. S. Dept. Agric.* 21 (1897).

This peculiar tree was discovered in the autumn of 1877 on the southern slopes of the Santa Rita Mountains in southern Arizona, growing with *Quercus hypoleuca* just below the forests of *Pinus Arizonica* and *Pinus Chihuahuana*, by Dr. Heinrich Mayr of the Bavarian Forest Department, who described it as a tree sixty feet high, with stout tortuous branches and deeply furrowed dark brown bark. (See, also, Brandegee, *Garden and Forest*, v. 111. — Toumey, *Garden and Forest*, viii. 22, f. 4.)

[6] This is probably the *Pinus Apacheca* of Lemmon (*Erythea*, ii. 103, t. 3 [1894]; *West-American Cone-Bearers*, 36), and is a common form of Yellow Pine on the mountains of southern New Mexico and Arizona, varying greatly in the length and breadth of its leaves and in the size of its cones. A fruiting branch of this form, gathered by Professor J. W. Toumey on the Chiricahua Mountains in 1896, is figured on plate dlxv. f. 2. This Yellow Pine, which is the largest tree of these forests, often produces a massive tall trunk covered with thick cinnamon-red bark broken into great plates and stout tortuous branches which form a broad open round-topped head. The four or five-leaved clusters first noticed by Professor Toumey on these trees on the Chiricahua Mountains in the spring of 1897 appear to connect *Pinus ponderosa* with the closely related *Pinus Arizonica*, which chiefly differs from that species in the greater number of leaves in its leaf-clusters.

resinous conspicuous bands of small summer cells, few small resin passages, and many obscure medullary rays. The specific gravity of the absolutely dry wood of the California tree is 0.4771, a cubic foot weighing 29.72 pounds. The wood of *Pinus ponderosa*, var. *Jeffreyi*, is coarser-grained, usually very resinous and light yellow, with pale yellow or nearly white and generally thinner sapwood. The specific gravity of the absolutely dry wood of this form is 0.5206, a cubic foot weighing 32.44 pounds. The wood of *Pinus ponderosa*, var. *scopulorum*, is coarser-grained, harder, more brittle and resinous, with a specific gravity, when absolutely dry, of 0.4619, a cubic foot weighing 28.78 pounds. The wood of *Pinus ponderosa*, var. *Mayriana*, is soft, brittle, and light red-brown, with thick pale sapwood, and contains broad dark bands of small very resinous summer cells, few resin passages, and obscure medullary rays. The specific gravity of the absolutely dry wood is 0.4970, a cubic foot weighing 30.96 pounds. The wood of *Pinus ponderosa* and its numerous forms is largely manufactured into lumber used for all sorts of construction, and is employed for railway ties, fencing, and fuel.

Indians, when other food failed, stripped the bark from the trunks of *Pinus ponderosa* in early spring, and ate the mucilaginous layer of forming wood, which they scraped from its inner surface.[1]

The first published allusion to *Pinus ponderosa* is in the journal of Lewis and Clark, who, in ascending the Missouri River in September, 1804, at the outset of their transcontinental journey, found the cones of this tree, brought down from the pineries of northwestern Nebraska, floating on White River, and heard of the Pine forests on the Black Hills of Dakota.[2] It was not made known to science, however, until 1826, when it was found near the Spokane River in May by David Douglas,[3] who suggested its specific name,[4] and in the following year introduced it into European plantations. In cultivation *Pinus ponderosa* has usually grown slowly, but its ability to adapt itself to the climate of western and northern Europe is shown by the existence of a few fine specimens in European collections.[5] In the eastern United States specimens of this Pine from the Pacific coast have not usually succeeded, and, although plants raised from seeds gathered in Colorado have proved hardy in the east, they grow slowly, and usually succumb at the end of a few years to various fungal diseases. Trees of some of the forms of the variety *Jeffreyi* are distinct and valuable park ornaments, thriving in central and northern Europe, where they have already produced their cones,[6] and in our eastern states, where they grow more rapidly and are less liable to disease than those of any of the other forms.[7]

Possessed of a constitution which enables it to endure great variations of climate and to flourish on the well-watered slopes of the California mountains, on torrid lava beds, in the dry interior valleys of the north and on the sun-baked mesas of the south, and to push out over the plains boldly, where no other tree can exist, the advance guard of the Pacific forest, *Pinus ponderosa* is the most widely distributed tree of western North America. Exceeded in size by the Sugar Pine of the Sierra Nevada, it surpasses all its race in the majesty of its port and the splendor of its vitality; and, an emblem of strength, it appears as enduring as the rocks, above which it raises its noble shafts and stately crowns.

[1] "The Pine trees had been stripped of their bark about the same season, which our Indian woman says her countrymen do in order to obtain the sap and the soft parts of the wood and bark for food." (*History of the Expedition under the Command of Lewis and Clark*, ed. Coues, ii. 424. — See, also, Newberry, *Popular Science Monthly*, xxx. 46 (*Food and Fibre Plants of the North American Indians*). — Sargent, *Garden and Forest*, x. 28. — Coville, *Contrib. U. S. Nat. Herb.* v. 89.)

[2] *History of the Expedition under the Command of Lewis and Clark*, *l. c.* i. 117, 119. (See Sargent, *l. c.* x. 28.)

[3] See ii. 94.

[4] Douglas, *Companion Bot. Mag.* ii. 111, 141 (1836).

[5] Fowler, *Gard. Chron.* 1872 (1326). — R. Hartig, *Forst.-Nat. Zeit.* i. 428. — J. G. Jack, *Garden and Forest*, vi. 14.

[6] Fowler, *l. c.* 1071. — R. Hartig, *l. c.* 429. — Hansen, *Garden and Forest*, v. 231. — Bolle, *Garden and Forest*, vii. 95.

[7] Probably the finest plants of Jeffrey's Pine in the eastern states are in Delaware Park in Buffalo, New York, where there are eight specimens, planted in 1871, varying in height from twenty-five to thirty-seven feet, with stems varying in girth at one foot above the surface of the ground from one foot nine inches to three feet nine inches.

EXPLANATIONS OF THE PLATES.

PLATE DLX. PINUS PONDEROSA.

1. An end of a branch with staminate flowers, natural size.
2. Portion of a staminate flower, enlarged.
3. Diagram of the involucre of the staminate flowers.
4. An anther, front view, enlarged.
5. An anther, side view, enlarged.
6. An end of a branch with pistillate flowers, natural size.
7. A pistillate flower, enlarged.
8. A scale of a pistillate flower, under side, with its bract, enlarged.
9. A scale of a pistillate flower, upper side, with its ovules, enlarged.
10. Tip of a leaf, enlarged.
11. Cross section of a leaf, magnified fifteen diameters.
12. A seedling plant, natural size.

PLATE DLXI. PINUS PONDEROSA.

1. A fruiting branch, natural size.
2. A seed, natural size.
3. Vertical section of a seed, enlarged.
4. An embryo, enlarged.
5. A cluster of leaves, natural size.

PLATE DLXII. PINUS PONDEROSA, var. JEFFREYI.

1. An end of a branch with staminate flowers, natural size.
2. Diagram of the involucre of the staminate flower.
3. Bract of a staminate flower, enlarged.
4. An involucre of a staminate flower, enlarged.
5. An anther, side view, enlarged.
6. An anther, front view, enlarged.
7. An end of a branch with pistillate flowers, natural size.
8. A scale of a pistillate flower, upper side, with its ovules, enlarged.
9. A scale of a pistillate flower, lower side, with its bract, enlarged.
10. Tip of a leaf, enlarged.
11. Cross section of a leaf magnified fifteen diameters.

PLATE DLXIII. PINUS PONDEROSA, var. JEFFREYI.

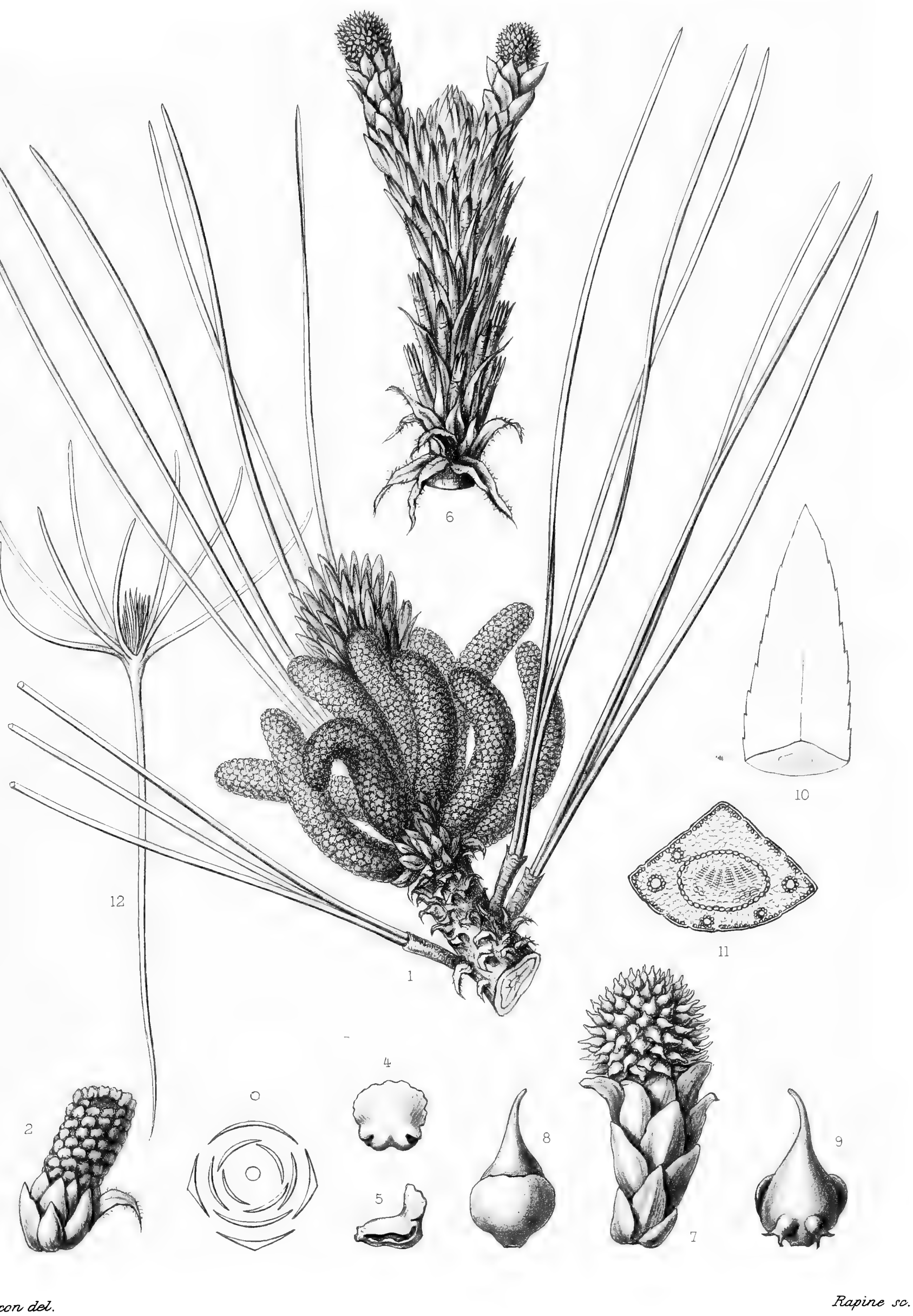
1. A fruiting branch, natural size.
2. A cone-scale, under side, natural size.
3. A cone-scale, side view, natural size.
4. A seed with its wing, natural size.
5. A seed with its wing, natural size.
6. A seed-wing, natural size.
7. Vertical section of a seed, enlarged.
8. An embryo, enlarged.

PLATE DLXIV. PINUS PONDEROSA, var. SCOPULORUM.

1. A fruiting branch, natural size.
2. A cluster of leaves, natural size.
3. A cluster of leaves, natural size.

PLATE DLXV. PINUS PONDEROSA.

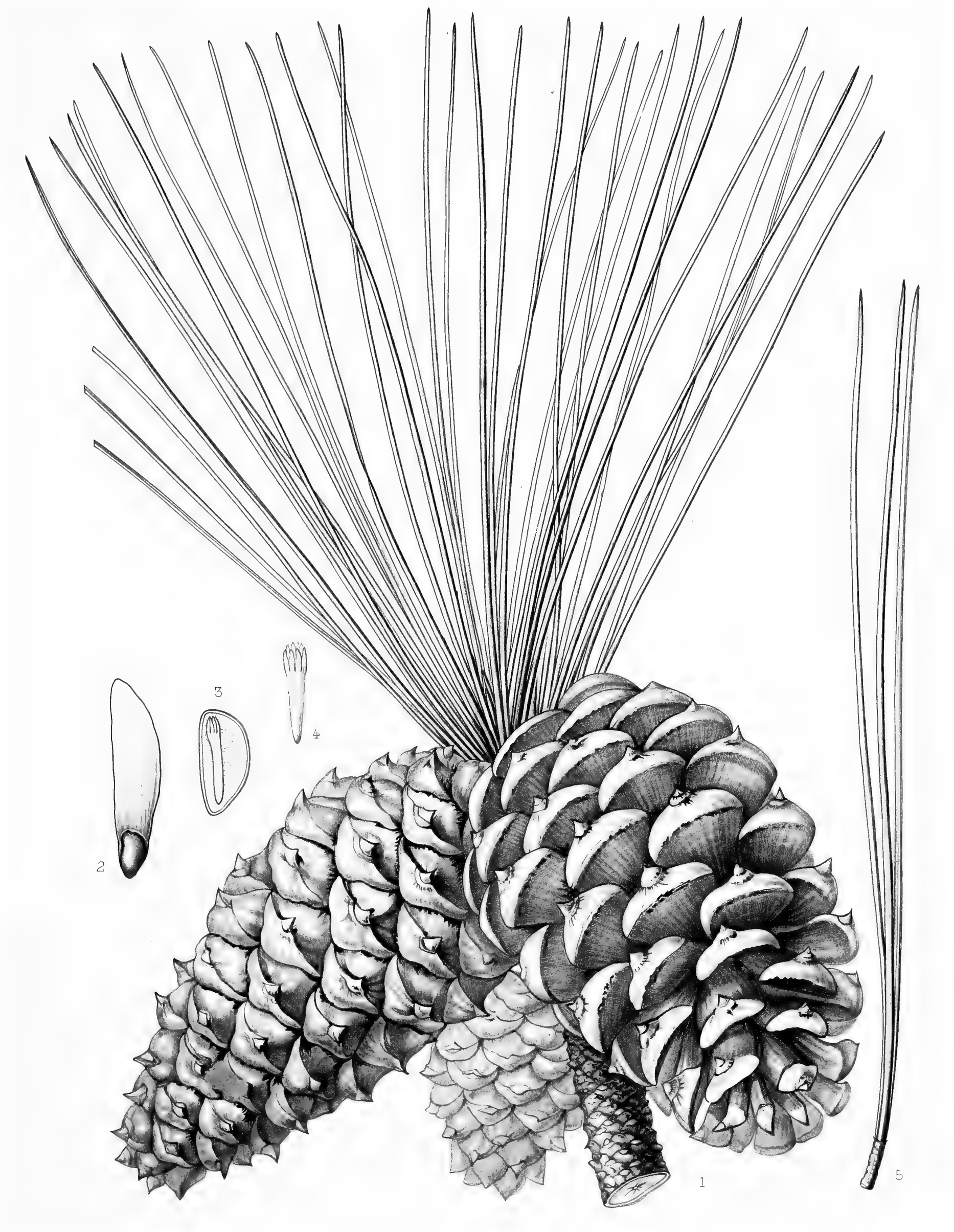
1. A fruiting branch of var. *Mayriana*, natural size.
2. A fruiting branch from a tree on the Chiricahua Mountains of Arizona, natural size.
3. A cone with entire base from a tree on the Chiricahua Mountains of Arizona, natural size.



C.E.Faxon del. *Rapine sc.*

PINUS PONDEROSA, Laws.

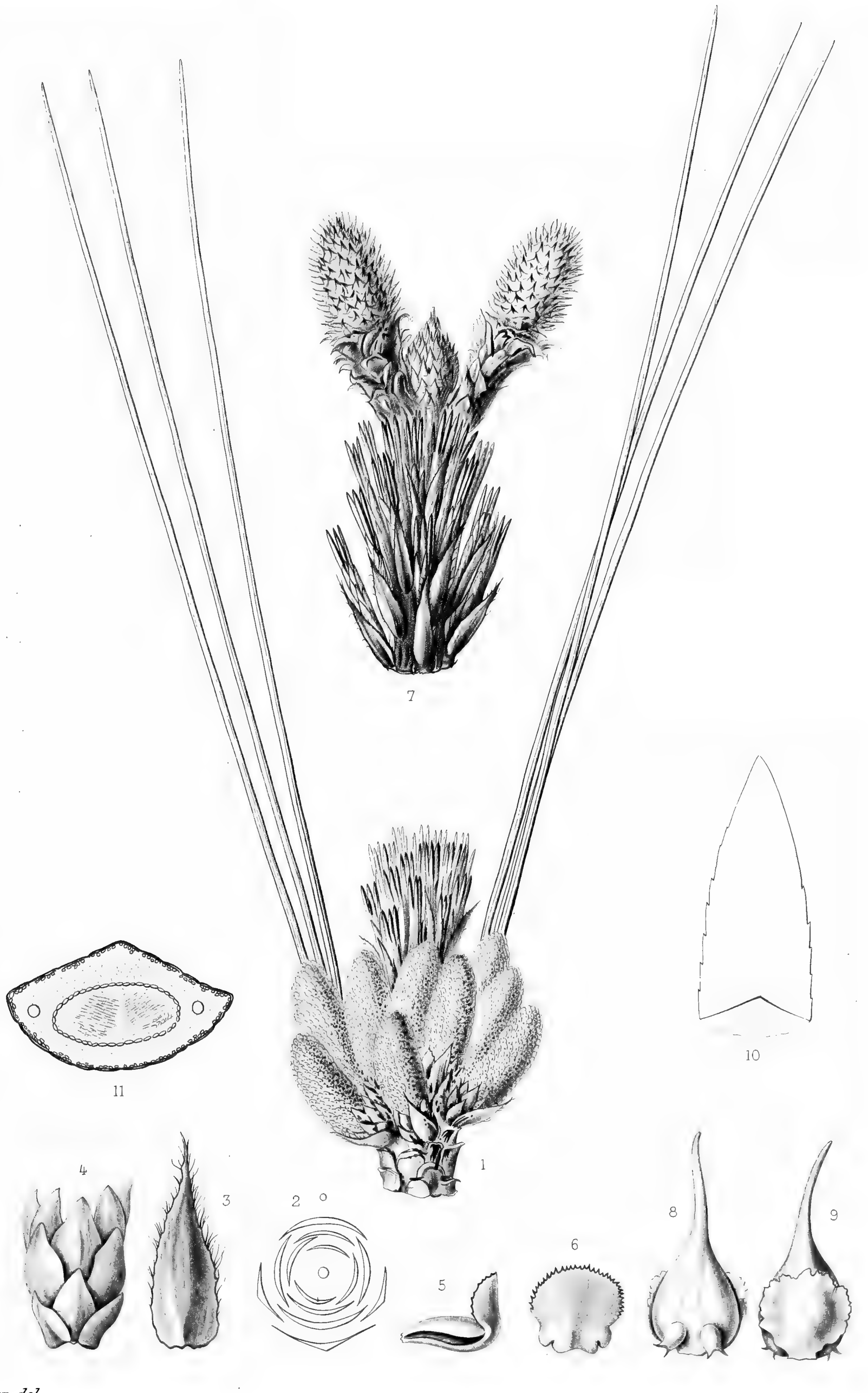
A.Riocreux direx.t *Imp. J.Taneur, Paris.*



C E. Faxon del. *Migneaux sc.*

PINUS PONDEROSA, Laws.

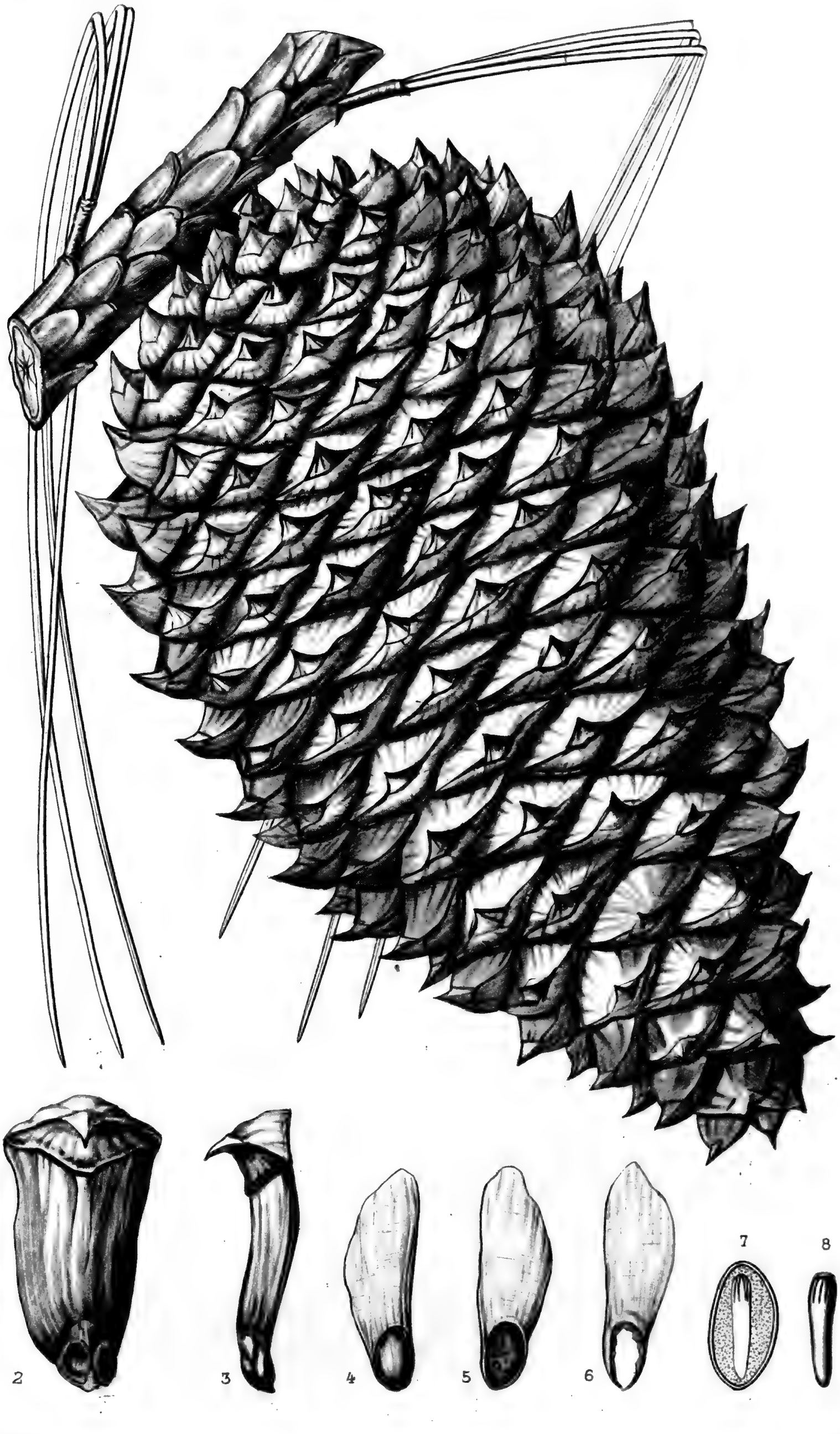
A Riocreux direx.t *Imp. J. Taneur, Paris.*



C.E. Faxon del. Lövendal sc.

PINUS PONDEROSA, var. JEFFREYI, Vasey.

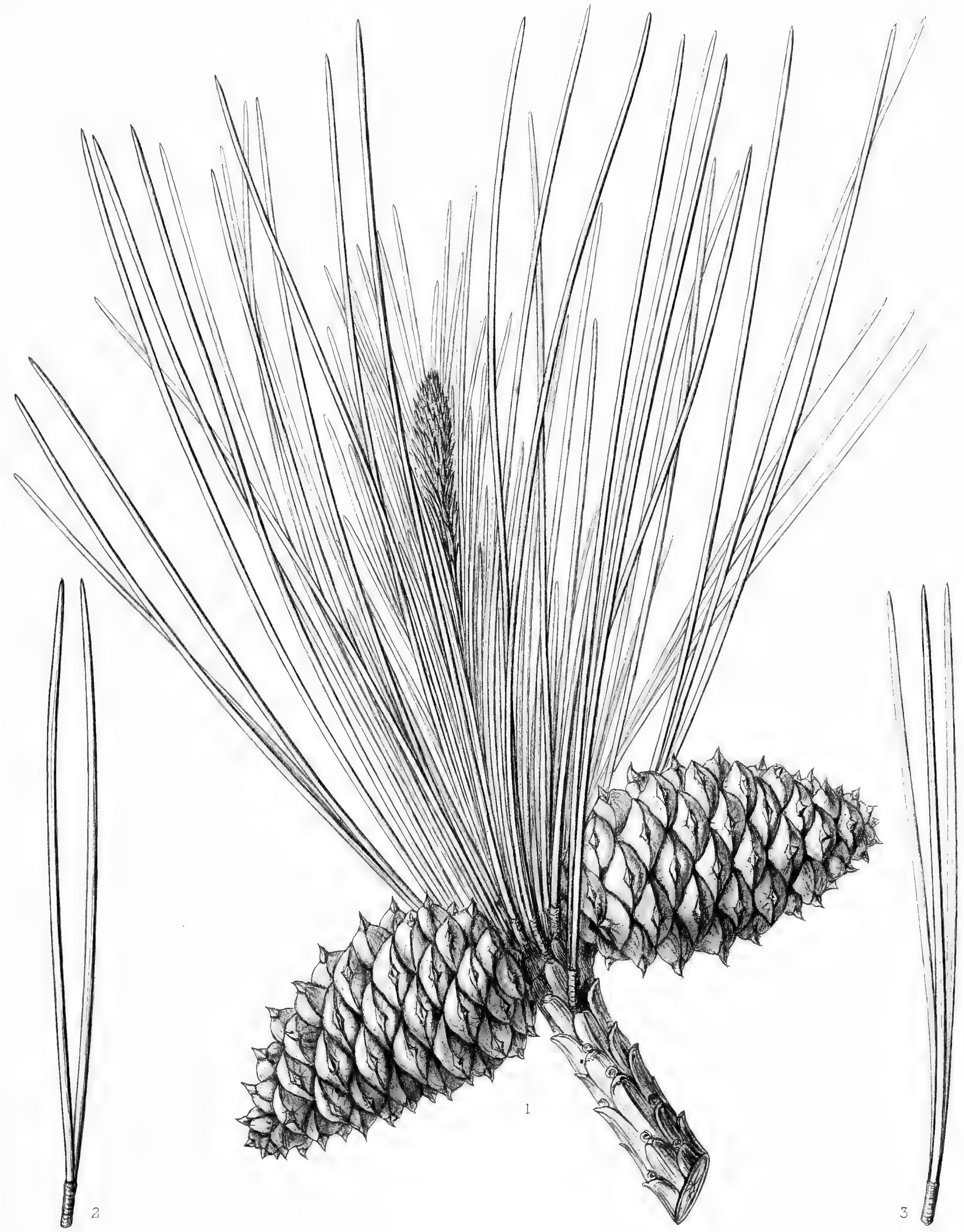
A. Riocreux direx.t Imp. J. Taneur, Paris.



C. E. Faxon del. Em. Himely sc.

PINUS PONDEROSA, var. JEFFREYI, Vasey.

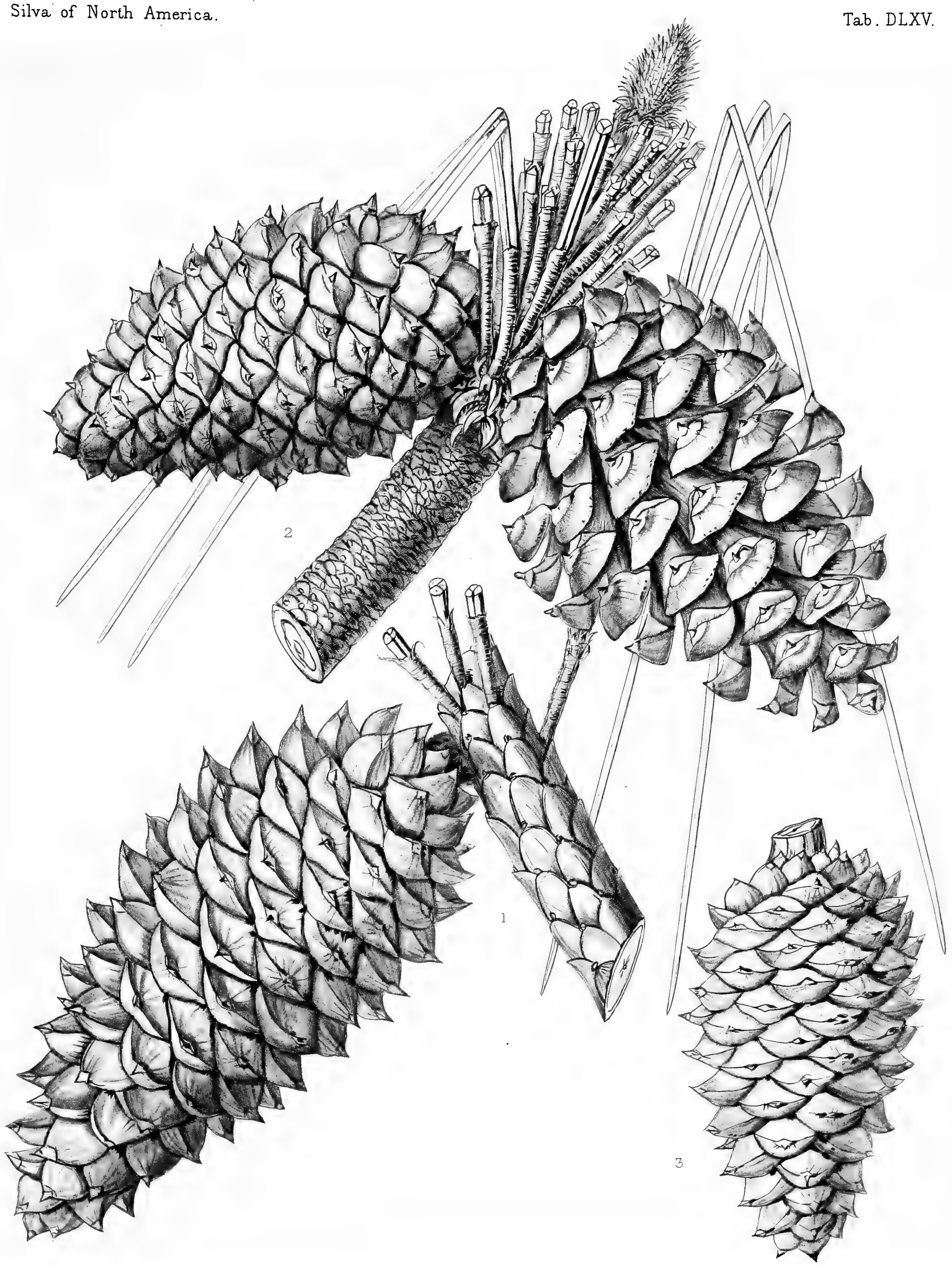
A. Riocreux direx.t Imp. J. Taneur, Paris.



C.E.Faxon del. Rapine sc.

PINUS PONDEROSA, var. SCOPULORUM, Engelm.

A.Riocreux direx.t Imp.J.Taneur, Paris.



C.E. Faxon del. Em. Himely sc.

PINUS PONDEROSA, Laws.

A. Riocreux direx.t Imp. J. Taneur, Paris.

PINUS CHIHUAHUANA.

Yellow Pine.

LEAVES in 3-leaved clusters, slender, pale green, from $2\frac{1}{2}$ to 4 inches in length, their sheaths deciduous. Cones broadly ovate, from $1\frac{1}{2}$ to 2 inches long, maturing at the end of the third season, their scales slightly thickened, furnished with small recurved deciduous prickles.

Pinus Chihuahuana, Engelmann, *Wislizenus Memoir of a Tour to Northern Mexico* (*Senate Doc.* 1848), Bot. Appx. 103 (1848); *Rothrock Wheeler's Rep.* vi. 262; *Trans. St. Louis Acad.* iv. 181. — Lindley & Gordon, *Jour. Hort. Soc. Lond.* v. 220. — Carrière, *Rev. Hort.* 1854, 227; *Fl. des Serres*, ix. 200; *Traité Conif.* 357. — Gordon, *Pinetum*, 193. — Henkel & Hochstetter, *Syn. Nadelh.* 86, 416. — Hoopes, *Evergreens*, 143. — Parlatore, *De Candolle Prodr.* xvi. pt. ii. 397. — Sargent, *Forest Trees N. Am. 10th Census U. S.* ix. 194. — Mayr, *Wald. Nordam.* 237, t. 8, f. — Beissner, *Handb. Nadelh.* 258. — Masters, *Jour. R. Hort. Soc.* xiv. 227. — Koehne, *Deutsche Dendr.* 34. — Lemmon, *West-American Cone-Bearers*, 44.

A tree, in the United States rarely more than forty or fifty feet in height, with a tall trunk sometimes two feet in diameter, and stout slightly ascending branches forming a narrow open pyramidal or round-topped head of thin pale foliage.[1] The bark of the trunk is from three quarters of an inch to an inch and a half in thickness, and is dark reddish brown or sometimes nearly black and deeply divided into broad flat ridges covered with thin closely appressed scales. The branchlets are slender, glabrous, bright orange-brown when they first appear, soon becoming dull red-brown, and during their first summer much roughened by the large persistent reflexed bases of the scales of the leaf-buds, which mostly fall during their first winter, although their scars do not entirely disappear for many years. The winter branch-buds are ovate, acute, from one quarter to one third of an inch in length, and covered by dark orange-brown scales with scarious more or less fringed margins. The leaves are borne in clusters of three, with loose chestnut-brown lustrous sheaths usually about half an inch long and deciduous during their first autumn; they are slender, acute with short callous tips, sharply serrulate, pale glaucous green, and conspicuously stomatiferous with from six to eight rows of stomata on each face; they contain two fibro-vascular bundles and two parenchymatous resin passages surrounded by strengthening cells, which also occur under the epidermis, usually in a single often interrupted layer, and begin to fall during their fourth season. The flowers appear in Arizona in July, the staminate in short crowded clusters, the pistillate generally in pairs on slender peduncles about a quarter of an inch in length and covered by ovate acute dark chestnut-brown bracts. The staminate flowers are oval, from one quarter to one third of an inch long, with yellow anthers terminating in conspicuous nearly orbicular crests slightly undulate on the margins, and are surrounded by ten involucral bracts. The pistillate flowers are oval, one third of an inch long, with broadly ovate yellow-green scales gradually contracted into long slender tips erect above and reflexed below the middle of the flower. During their first winter the young cones are erect and from one third to nearly one half of an inch in length; the following autumn they are horizontal or slightly pendulous, subglobose, and almost an inch in diameter, and when they mature a year later they are broadly ovate, acute, dark green, from an inch and a half to two inches long, and nearly horizontal or occasionally slightly ascending and raised on slender rigid naked peduncles from one third to one quarter of an inch in length; their thin flat scales, which are about a quarter of an inch wide, are only slightly

[1] See Toumey, *Garden and Forest*, viii. 22, f. 3.

EXPLANATION OF THE PLATE.

Plate DLXVI. Pinus Chihuahuana.

1. A branch with staminate flowers, natural size.
2. A staminate flower, enlarged.
3. A bract of a staminate flower, enlarged.
4. Diagram of the involucre of the staminate flower.
5. An anther, front view, enlarged.
6. An anther, side view, enlarged.
7. End of a branch with pistillate flowers, natural size.
8. A pistillate flower, enlarged.
9. A scale of a pistillate flower, upper side, with its ovules, enlarged.
10. A scale of a pistillate flower, lower side, with its bract, enlarged.
11. A fruiting branch, natural size.
12. A cone at the end of its second season, natural size.
13. A cone with its peduncle, natural size,
14. A cone-scale, upper side, with its seeds, natural size.
15. A cluster of leaves, natural size.
16. A cluster of young leaves, with its sheath, natural size.
17. Tip of a leaf, enlarged.
18. Cross section of a leaf, magnified fifteen diameters.

C.E. Faxon del. Himely sc.

PINUS CHIHUAHUANA, Engelm.

A. Riocreux direx.t Imp. J. Taneur, Paris.

PINUS CONTORTA.

Scrub Pine.

LEAVES in 2-leaved clusters, dark green, from 1 to 2 inches in length. Cones oval or subcylindrical, oblique, from ¾ to 2 inches long, their scales armed with slender prickles.

Pinus contorta, Loudon, *Arb. Brit.* iv. 2292, f. 2210, 2211 (1838). — Nuttall, *Sylva*, iii. 117. — Endlicher, *Syn. Conif.* 168. — Dietrich, *Syn.* v. 399. — Carrière, *Traité Conif.* 364. — Torrey, *Pacific R. R. Rep.* iv. pt. v. 141. — Gordon, *Pinetum*, 165. — Lyall, *Jour. Linn. Soc.* vii. 133, 141 (in part). — Henkel & Hochstetter, *Syn. Nadelh.* 24. — Hoopes, *Evergreens*, 81 (in part). — Parlatore, *De Candolle Prodr.* xvi. pt. ii. 381 (in part). — Watson, *King's Rep.* v. 330. — K. Koch, *Dendr.* ii. pt. ii. 301. — Engelmann, *Trans. St. Louis Acad.* iv. 182; *Brewer & Watson Bot. Cal.* ii. 126; *Gard. Chron.* II. ser. xix. 351. — Veitch, *Man. Conif.* 145. — Kellogg, *Trees of California*, 65. — Sargent, *Forest Trees N. Am. 10th Census U. S.* ix. 194. — Lauche, *Deutsche Dendr.* ed. 2, 109. — Regel, *Russ. Dendr.* ed. 2, pt. i. 47. — Lemmon, *Rep. California State Board Forestry*, ii. 72, 92, t. (*Pines of the Pacific Slope*); *West-American Cone-Bearers*, 28. — Steele, *Proc. Am. Pharm. Assoc.* 1889, 236 (*The Pines of California*). — Mayr, *Wald. Nordam.* iii. 333, t. 8, f. — Beissner, *Handb. Nadelh.* 219. — Masters, *Jour. R. Hort. Soc.* xiv. 227. — Hansen, *Jour. R. Hort. Soc.* xiv. 356 (*Pinetum Danicum*). — Koehne, *Deutsche Dendr.* 36.

Pinus inops, Bongard, *Mém. Phys. Math. et Nat. pt. ii. Acad. Sci. St. Pétersbourg*, ii. 163 (*Vég. Sitcha*) (not Aiton) (1831). — Hooker, *Fl. Bor.-Am.* ii. 161 (in part). — Ledebour, *Fl. Ross.* iii. 676. — Herder, *Act. Hort. Petrop.* xii. 86 (*Pl. Radd.*).

Pinus Banksiana, Lindley & Gordon, *Jour. Hort. Soc. Lond.* v. 218 (in part) (not Lambert) (1850).

Pinus Boursieri, Carrière, *Rev. Hort.* 1854, 225, f.; *Fl. des Serres*, ix. 200, f.; *Traité Conif.* 398. — Sénéclauze, *Conif.* 132. — Courtin, *Fam. Conif.* 82. — Hansen, *Jour. R. Hort. Soc.* xiv. 351 (*Pinetum Danicum*).

Pinus muricata, Bolander, *Proc. Cal. Acad.* iii. 227, 317 (not D. Don) (1866).

Pinus Bolanderi, Parlatore, *De Candolle Prodr.* xvi. pt. ii. 379 (1869).

Pinus contorta, var. **Bolanderi**, Vasey, *Rep. Dept. Agric. U. S.* 1875, 177 (*Cat. Forest Trees U. S.*) (1876). — Koehne, *Deutsche Dendr.* 37. — Lemmon, *West-American Cone-Bearers*, 29.

Pinus contorta, var. (b) **Hendersoni**, Lemmon, *West-American Cone-Bearers*, 30 (1895).

A tree, usually fifteen or twenty or occasionally thirty feet tall, with a short trunk rarely more than eighteen inches in diameter and comparatively stout branches which form a round-topped compact and symmetrical or an open picturesque head, and sometimes fertile when only a few inches in height.[1] The bark of the trunk is from three quarters of an inch to an inch in thickness and is deeply and irregularly divided by vertical and cross fissures into small oblong plates covered with closely appressed dark red-brown scales tinged with purple or orange-color; on smaller stems and large branches it is thin, smooth, and dark or light red-brown. The branch-buds are ovate, acute, and from one quarter to nearly one half of an inch in length, and covered by long-pointed dark chestnut-brown scales scarious and more or less broken on the margins, those of the outer ranks being usually loosely imbricated and much reflexed above the middle; while those of the inner ranks soon become reflexed on the growing shoots and, losing their tips, continue for years to roughen with their thickened dark brown bases the stout branches. These, when they first appear, are glabrous and light orange-color, and, gradually growing darker during their second and third seasons, finally become dark red-brown or

[1] Lemmon (*Erythea*, ii. 174) describes trees growing in rich loam near the mouth of the Noyo River in Mendocino County, California, near the southern limits of the range of this species, from fifty to eighty feet tall, with trunks from two to five feet in diameter covered with deeply rimose bark two inches thick. These trees are exceptionally large. The white clay barrens which stretch for miles along the coast of Mendocino County are covered with cone-bearing plants of *Pinus contorta* and *Cupressus Goveniana* only a few inches high, while in the better soil and more abundant moisture of depressions in this plain they sometimes rise to a height of thirty feet.

occasionally almost black. The leaves are borne in clusters of two, with loose scarious sheaths from one quarter to nearly one third of an inch in length, their inner scales falling during the first summer or autumn and leaving only the narrow bases of the sheaths, which thicken and become almost black and fall with the leaves, usually in their seventh or eighth year; they are acute with short callous tips, finely and sharply serrate, dark green, stomatiferous with from six to ten rows of deep-set stomata on each face, from an inch to an inch and a half long and about one twenty-fourth of an inch wide, and contain two fibro-vascular bundles and one or two parenchymatous resin passages surrounded by strengthening cells, which also occur in a single nearly continuous layer under the epidermis.[1] The staminate flowers are borne in short crowded spikes and are cylindrical and about half an inch long, with orange-red anthers terminating in semiorbicular nearly entire crests, and are surrounded by involucres of six bracts. The pistillate flowers are subterminal or rarely lateral, clustered or in pairs, erect or nearly horizontal, borne on stout peduncles covered by ovate acute dark chestnut-brown bracts, and subcylindrical, with orange-red ovate scales gradually narrowed into elongated tips. During their first winter the young cones are oval, spreading or erect, and from one half to three quarters of an inch in length, with much thickened light red-brown scales produced into long slender points; and when ripe in the following autumn they are oval or subcylindrical, usually very oblique at the base, horizontal, often clustered, light green, and from three quarters of an inch to two inches in length, with thin slightly concave scales rounded at the apex, their exposed parts being transversely keeled and slightly thickened into narrow oblong dark umbos armed with long slender more or less recurved often deciduous prickles, or toward the base of the cone, and especially on the upper side, the exposed portions of the scales are developed into thick mammillate knobs; at maturity they become light yellow-brown and lustrous, sometimes opening and exposing the bright red-purple inner portion of the scales, and losing their seeds as soon as ripe; or more often they are serotinous, remaining unopened on the branches and preserving the vitality of their seeds for many years, although most of them eventually open before falling and continue to cover for many seasons longer the stems and branches. The seeds are oblique at the apex, acute below, dark red-brown mottled with black, and about one sixteenth of an inch in length, with a thin brittle coat and an embryo with four or five cotyledons; their wings are thin, pale brown, widest above the base, gradually tapering toward the oblique apex, and half an inch long.

Pinus contorta is distributed from Alaska, where it grows near the coast as far north, at least, as the shores of Cross Sound,[2] usually in sphagnum-covered bogs, southward in the immediate neighborhood of the coast to the valley of the Albion River in Mendocino County, California, south of the northern boundary of the United States, generally inhabiting sand dunes and barrens, or occasionally, near the shores of Puget Sound, the margins of tide pools and sphagnum-covered swamps. Spreading inland, it ascends the coast ranges and western slopes of the Cascade Mountains,[3] where it is not common, and where it gradually changes its habit and appearance, the thick dark deeply furrowed bark of the coast form being found only near the ground, that which is higher on the stem being thin, light-colored, and more inclined to separate into scales, while the leaves are often longer and broader. In British Columbia, Oregon, and Washington such trees are found, either singly or in small groves, scattered over the coast ranges and on the western slopes of the Cascade Mountains up to elevations of four or five thousand feet above the sea. Farther east they grow taller, their bark is thinner, and their leaves broader, and insensibly through innumerable forms the Pine of the wind-swept coast dunes passes into the Lodge Pole or Tamarack Pine[4] of the interior.[5] This is a tree,

[1] Coulter & Rose, *Bot. Gazette*, xi. 305.

[2] Rothrock, *Smithsonian Rep.* 1867, 455 (*Fl. Alaska*). — Meehan, *Proc. Phil. Acad.* 1884, 92. — F. Kurz, *Bot. Jahrb.* xix. 425 (*Fl. Chilcatgebietes*). — M. W. Gorman, *Pittonia*, iii. 69.

[3] Hall, *Bot. Gazette*, ii. 94. — Henderson, *Zoë*, ii. 207.

[4] In the northern Rocky Mountains this tree is almost universally called Lodge Pole Pine, because its long slender stems afforded the best support for the Indian tepees, while in California it is as generally known as Tamarac, from the resemblance of the narrow spire-like heads which it produces on the high Sierras to those of the Larch-tree of the eastern states.

[5] *Pinus contorta*, var. *Murrayana*, Engelmann, *Brewer & Watson Bot. Cal.* ii. 126 (1880). — Coulter, *Man. Rocky Mt. Bot.* 433. —

usually seventy or eighty but often one hundred and fifty feet in height, with a trunk generally from two to three but occasionally five or six feet in diameter, and slender much forked branches frequently persistent nearly to the base of the stem, which are light orange-color during their early years and somewhat pendulous below, and ascending near the top of the tree form a narrow pyramidal spire-topped head. In the extreme form the bark of the trunk is rarely more than a quarter of an inch in thickness, close and firm, light orange-brown, and covered by small thin loosely appressed scales. The leaves are yellow-green and usually about two inches long, although they vary from one to three inches in length, and are from one sixteenth to nearly one eighth of an inch in width. The cones occasionally open as soon as ripe but are usually serotinous, preserving the vitality of their seeds sometimes for twenty years.[1]

Beissner, *Handb. Nadelh.* 219. — Masters, *Jour. R. Hort. Soc.* xiv. 227. — Koehne, *Deutsche Dendr.* 37.

Pinus inops, Bentham, *Pl. Hartweg.* 337 (not Aiton) (1857).

Pinus Murrayana, A. Murray, *Rep. Oregon Exped.* 2, t. 3, 62 (1853) ; *Edinburgh New Phil. Jour.* n. ser. xi. 226 ; *Trans. Bot. Soc. Edinburgh*, vi. 351. — Sargent, *Forest Trees N. Am.* 10*th Census U. S.* ix. 194. — Lemmon, *Rep. California State Board Forestry*, ii. 72, 92, t. (*Pines of the Pacific Slope*) ; *West-American Cone-Bearers*, 30, t. 4. — Steele, *Proc. Am. Pharm. Assoc.* 1889, 236 (*The Pines of California*). — Mayr, *Wald. Nordam.* 348, t. 8, f. — Hansen, *Jour. R. Hort. Soc.* xiv. 378 (*Pinetum Danicum*). — Merriam, *North American Fauna*, No. 7, 339 (*Death Valley Exped.* ii.).

Pinus contorta, Newberry, *Pacific R. R. Rep.* vi. pt. iii. 34, 90, t. 5, f. 11 (not Loudon) (1857). — Engelmann, *Am. Jour. Sci.* ser. 2, xxxiv. 332. — Lyall, *Jour. Linn. Soc.* vii. 141 (in part). — Cooper, *Am. Nat.* iii. 409. — Parlatore, *De Candolle Prodr.* xvi. pt. ii. 381 (in part). — Masters, *Gard. Chron.* n. ser. xix. 45, f. 5.

Pinus Tamrac, A. Murray, *Gard. Chron.* 1869, 191, f. 1–9.

Pinus contorta, var. *latifolia*, Watson, *King's Rep.* v. 331 (1871). — Porter & Coulter, *Fl. Colorado ; Hayden's Surv. Misc. Pub.* No. 4, 129. — Engelmann, *Rothrock Wheeler's Rep.* vi. 262.

Pinus Murrayana, var. *Sargentii*, Mayr, *l. c.* 349 (1890).

It would probably be hopeless to try to convince a person who had seen these trees only on the high California Sierras, in the Yellowstone National Park, and on the sand dunes of the Pacific coast, that *Pinus Murrayana* and *Pinus contorta* were forms of one species, although they do not differ in their organs of reproduction except in the size of the cones, which varies considerably on different individuals. The extreme forms vary in their habit, in the thickness, color, and nature of their bark, in the character of their wood, in the length and breadth of their leaves, and in the size of their cones ; one is a tall pyramidal tree of high mountains and plateaus with orange-colored bark thinner than that of any other Pine and soft straight-grained wood with inconspicuous summer cells and more like that of a White Pine or of a Spruce than of a Pinaster, and with broad yellow-green leaves ; the other is a low round-headed coast tree with stout contorted branches, thick dark deeply furrowed bark, coarse-grained wood conspicuously marked by broad dark bands of resinous summer cells, and slender dark green leaves. In the region, however, between the coast and the northern Rocky Mountains there are other forms, some with broad and others with narrow leaves, some with bark as rough as that of the coast tree, and others with the thin bark of the mountain tree ; on some trees dark thick bark occurs only at the base of the trunk, on others it extends several feet above it and gradually passes into the thin orange-colored bark of the mountain tree. The wood, too, of the trees of the Olympic and Cascade Mountains, of the ranges of western Washington and Oregon, and of northern Idaho and Montana, varies like the bark, and individuals may be found growing under apparently identical conditions with the pale soft wood of one form and with the dark resinous wood of the other ; and after wandering for months among these trees and seeing them in all their aspects, on the Yellowstone plateau, in northern Montana and Idaho, on the Blue Mountains of eastern Oregon, on the Cascades and the Olympics, along the coast from the shores of the Straits of Fuca to those of Humboldt Bay, on the borders of alpine meadows and the moraines of the Sierra Nevada, and on the mountains of Colorado, the conclusion forced itself upon me that a single species, greatly changed in some respects by its surroundings in different localities, but always with the same organs of reproduction, extends over this wide region.

[1] In 1874 Dr. George Engelmann gathered on the Rocky Mountains of Colorado a branch of *Pinus contorta*, var. *Murrayana*, bearing closed cones, which had ripened during each of the previous nine years, with the exception of 1867, when none had been produced. In the spring of 1879 seeds from the cones of each year were planted at the Arnold Arboretum. Those from the cones which had ripened in 1866 did not germinate, but a part of the seeds of later years produced seedlings, showing that the seeds of this tree may preserve their vitality in closed cones for as long a period as nine years, although under ordinary conditions Pine seeds are extremely perishable. (See Sargent, *Bot. Gazette*, v. 54. — Engelmann, *Bot. Gazette*, v. 62.)

This special arrangement for protecting the vitality of its seeds, and their power to germinate quickly on burnt soil after liberation, have enabled *Pinus contorta* to maintain itself against adverse conditions and to play a controlling part in determining the character of the forests over large areas in the northern Rocky Mountain region. Fires are constantly sweeping through these forests, killing, without consuming, these highly resinous trees, of which they are now at certain altitudes often almost exclusively composed. The heat opens the cones and liberates the seeds of many years, and these, falling in immense numbers on the burnt surface of the ground, germinate quickly, and, growing rapidly, soon cover it to the exclusion of other plants, forming such dense forests that a man can hardly find passage between the slender stems of its trees. These trees begin to bear cones profusely when only a few years old, and are soon ready to furnish seeds to repair the damage of another fire. This alternate burning of older trees and springing up of crops of seedlings on the same ground may go on for generations ; and it is common to see on the Rocky Mountains the dead trunks of three or four crops standing over a dense young growth. In this way the Lodge Pole Pine is not only able to hold its own on ground of which it has once taken possession, but also to gain and maintain a foothold where fire has destroyed other trees less well

Pinus contorta, var. *Murrayana*, is common on the Alaska hills, where it sometimes attains a height of one hundred feet and a trunk diameter of eighteen inches,[1] and finds its most northerly home in the valley of the Yukon River. It is the prevailing and characteristic tree on the interior plateau of northern British Columbia, crossing the Rocky Mountains to the hills between the Athabasca River and Lesser Slave Lake, and spreading southward along their eastern foothills at elevations of about four thousand feet above the level of the sea to the Cypress Hills in southern Assiniboia; it is common in the interior of southern British Columbia on sandy benches and river flats and on mountain slopes above a level of three thousand five hundred feet, often covering with dense forests great areas of sandy soil in the basin of the upper Columbia.[2] In the United States the Lodge Pole Pine forms forests on both slopes of the Rocky Mountains of Montana; it is the prevailing tree on the Yellowstone plateau in northwestern Wyoming, which at elevations from seven thousand to seven thousand five hundred feet it covers with a dense nearly continuous forest;[3] it is also common on the Big Horn and other mountain ranges of Wyoming, extending southward to those of southern Colorado, where it abounds at elevations from ten to eleven thousand feet above the sea,[4] and to eastern Utah; from the western slope of the Rocky Mountains of Montana it spreads over the Bitter Root Mountains of Idaho and over the ranges of eastern Washington and Oregon, where, usually at elevations from four thousand five hundred to five thousand feet, it forms on high ridges great continuous forests; it is common on the mountains of northern California and ranges southward along the Sierra Nevada, where it attains its greatest size and beauty and is the principal inhabitant of the alpine forest, growing above the Firs on moraines extending for miles along the sides of rocky valleys at elevations between eight thousand and nine thousand five hundred feet above the sea-level, and on the rich alluvium of sheltered lake bottoms, where, four or five inches in diameter and forty or fifty feet in height,[5] its stems are crowded like blades of grass; on Gray Back of the San Bernardino Range in southern California it forms the timber line, at heights of about ten thousand feet, with a nearly continuous belt, descending three thousand feet lower with individuals scattered through the forest of Yellow Pine, and in Bear Valley among the San Jacinto Mountains it finds its most southerly home with small scattered groves at elevations of six thousand feet.[6]

The wood of *Pinus contorta* is light, hard, strong, although brittle and coarse-grained; it is light brown tinged with red, with thick nearly white sapwood, and contains broad very conspicuous bands of small resinous summer cells, numerous small resin passages, and many obscure medullary rays. The specific gravity of the absolutely dry wood is 0.5815, a cubic foot weighing 36.24 pounds. On the coast of California it is used for fuel. The wood of the variety *Murrayana* is light, soft, not strong, close, straight-grained, and easily worked but not durable; it is light yellow or nearly white, with thin lighter colored sapwood, and contains narrow inconspicuous bands of small summer cells, few small

able to reproduce themselves under unnatural conditions; and regions formerly clothed with Spruces, Firs, and other Pines appear destined to receive a forest-covering of *Pinus contorta*, which, although comparatively worthless as a timber-tree, is of inestimable value in preserving the integrity of mountain slopes and protecting the flow of mountain streams.

[1] M. W. Gorman, *Pittonia*, iii. 69.

[2] G. M. Dawson, *Can. Nat.* ser. 2, ix. 327. — Macoun, *Cat. Can. Pl.* 466.

"On the authority of Mr. W. H. Dall the northern limit of this tree has been given at the confluence of the Pelly and Lewis Rivers (lat. 62° 49′ north); but as it there shows no sign of having reached its extreme point, it may probably be found some distance farther northward in the Yukon valley, although not so far as the mouth of the Porcupine in latitude 63° 33′." (G. M. Dawson, *Garden and Forest*, i. 59.)

Pinus contorta, var. *Murrayana*, was found by Mr. Dawson growing abundantly on the Stikive immediately east of the coast mountains and thence inland; and on the Dease and upper Liard and from the mouth of the Dease down the Liard to Devil's Portage, some miles east of the range which apparently represents the northern continuation of the Rocky Mountains. Farther east *Pinus divaricata* is the Pine of the great valley of the Mackenzie, although it does not extend west of the Rocky Mountains to the head-waters of the Liard. *Pinus contorta*, var. *Murrayana*, does not occur on the upper Pelly, in ascending which it was first met with by Dr. Dawson in longitude 133° 30′. From this point down the Pelly and up the whole length of the Lewes it is moderately abundant (G. M. Dawson, *l. c.*).

[3] Tweedy, *Garden and Forest*, i. 129 (*Forests of the Yellowstone National Park*).

[4] Brandegee, *Bot. Gazette*, iii. 32.

[5] Muir, *The Mountains of California*, 200.

[6] S. B. Parish, *Zoë*, iv. 351.

resin passages, and numerous obscure medullary rays. The specific gravity of the absolutely dry wood is 0.4096, a cubic foot weighing 25.53 pounds. It is occasionally manufactured into lumber, and is also used for railway ties and mine timbers, and as fuel.

In Alaska a sort of coarse bread is made from the inner bark;[1] and in eastern Oregon the cambium layer of the variety *Murrayana* is sometimes eaten by Indians, who make baskets from sections of the bark of this tree to hold berries.[2]

Pinus contorta was discovered on the mountains above the head of the Jefferson River by Lewis and Clark in August, 1805, as they were crossing the Rocky Mountains;[3] and on the second of November they encountered what was probably the coast form near the mouth of the Columbia River.[4]

Introduced into English gardens in 1831 by David Douglas, who first made it known to science, the coast tree is occasionally cultivated in Europe, although it has little to recommend it as an ornamental plant.[5] The variety *Murrayana*, which in its name commemorates Andrew Murray,[6] was found by John Jeffrey on the Siskiyou Mountains in northern California and by him was introduced into Europe. This form has proved hardy in eastern Massachusetts, where it has been cultivated in the Arnold Arboretum since 1875, and has produced cones, although, like the other Pines from the Rocky Mountains, it suffers when transferred to the Atlantic seaboard from fungal diseases.

[1] When the sap rises at the end of June or early in July the Alaska Indians fell the trees of this Pine and of the Hemlock and strip off the bark in pieces ten or twelve feet long. The inner bark is then brought into camp in canoes, picked by the women into small pieces, mixed with water into a consistent mass, and moulded in frames into cakes about eleven inches square. A hole is then dug in the ground and sand or small stones placed on the bottom and thoroughly heated. The fire is then removed and a layer of the fresh leaves of the western Skunk Cabbage (*Lysichiton Kamtschatcensis*, Schott) is placed over them. A layer of cakes is placed on these leaves, and this process is repeated until there are five or six layers of cakes. On top of the whole, damp moss or seaweed is piled, a fire is built, and the whole mass is cooked for about an hour. The cakes are then removed and placed on Thuya slats in a smoke-house, and smoked for four or five days, when they will keep indefinitely. After cooking and smoking, the cakes are put up in oblong bundles somewhat resembling a quintal of codfish, and are covered by long strips of matting made of Thuya bark, and securely tied by ropes of this bark for convenience of transport in canoes. The bread is used by breaking the cake into pieces, pouring hot or boiling water over them until they become soft, and then placing them on the snow to cool, and covering them with ulikon grease, when they are ready to eat. Sometimes the cake is broken into pieces, and these are put into stone mortars and reduced to powder, which is sprinkled over boiled smoked salmon or other food. Children and young adults eat the bread with apparent relish in its natural state; but older people are unable to do this because their teeth are worn down by long-continued use in eating dried smoked salmon and other hard substances.

This preparation from the bark of *Pinus contorta* is usually eaten within a few days after it has been cooked, as, if it is kept for any length of time, it develops a resinous flavor that is not palatable even to an Alaskan Indian. The Hemlock-bark bread, however, can be kept indefinitely, and is therefore usually put up for winter use (M. W. Gorman *in litt.*).

[2] Coville, *Contrib. U. S. Nat. Herb.* v. 89.

[3] The "mountains continue high on each side of the valley, but their only covering is a small species of Pitch Pine with a short leaf, growing on the lower and middle regions, while for some distance below the snow-tops there is neither timber nor herbage of any kind." (*History of the Expedition under Command of Lewis and Clark*, ed. Coues, ii. 457. — Sargent, *Garden and Forest*, x. 28.)

[4] *History of the Expedition under Command of Lewis and Clark*, *l. c.* 668. — Sargent, *l. c.* 29.

[5] Fowler, *Gard. Chron.* 1872, 1070.

[6] Andrew Murray (1812–1878) was born in Edinburgh, and, being educated for the law, obtained the position of Writer to the Signet, although his predilections were for natural history, in which he became interested as a boy. While best known, perhaps, as an entomologist, he wrote a number of papers on botany, especially on the Conifers of Japan and of western North America. He was chosen secretary of the association which sent Jeffrey to America, and, with Professor Balfour, described many of the plants that he discovered. In 1858 Mr. Murray was elected president of the Botanical Society of Edinburgh, and two years later, having been made assistant secretary of the Horticultural Society of London, he established himself in that city, and devoted the remainder of his life to the affairs of the society and to the publication of numerous scientific papers and Lawson's *Pinetum Britanicum*, of which he was one of the editors. His most important dendrological papers are a circular addressed to the subscribers of the Oregon Association, probably printed in 1853, and containing the first descriptions and figures of several western American Conifers; two papers on California Conifers, published in 1855 and 1859 in the Edinburgh *New Philosophical Journal*; *The Pines and Firs of Japan*, first published in 1862 in the *Proceedings of the Royal Horticultural Society*, and a paper on the *Synonymy of Various Conifers*, published a year later in the *Proceedings* of that society.

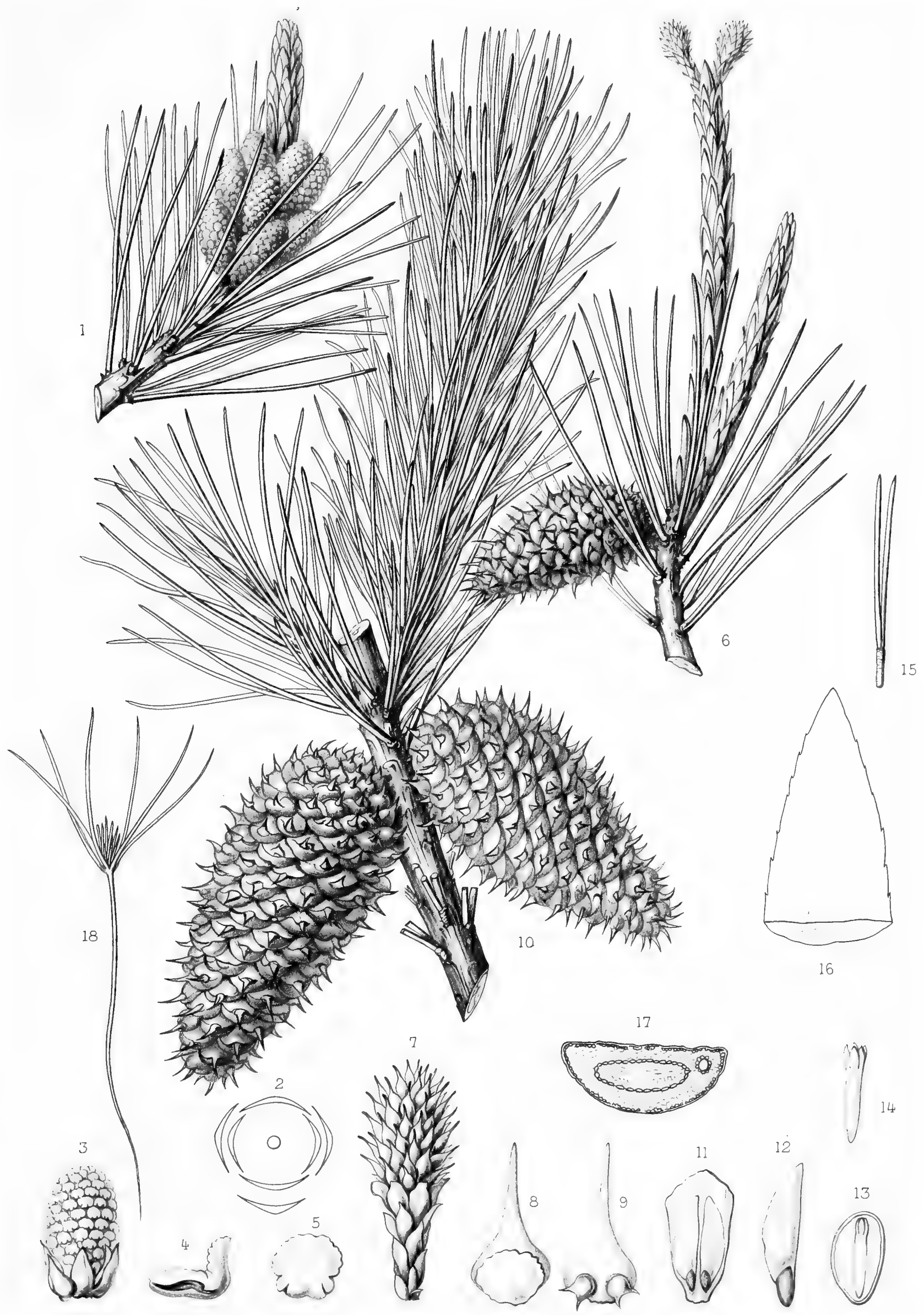
EXPLANATION OF THE PLATES.

PLATE DLXVII. PINUS CONTORTA.

1. A branch with staminate flowers, natural size.
2. Diagram of the involucre of the staminate flower.
3. A staminate flower, enlarged.
4. An anther, side view, enlarged.
5. An anther, front view, enlarged.
6. A branch with pistillate flowers, natural size.
7. A pistillate flower, enlarged.
8. A scale of a pistillate flower, lower side, with its bract, enlarged.
9. A scale of a pistillate flower, upper side, with its ovules, enlarged.
10. A fruiting branch, natural size.
11. A cone-scale, lower side, enlarged.
12. A seed, enlarged.
13. Vertical section of a seed, enlarged.
14. An embryo, enlarged.
15. A cluster of young leaves, natural size.
16. Tip of a leaf, enlarged.
17. Cross section of a leaf, magnified fifteen diameters.
18. A seedling plant, natural size.

PLATE DLXVIII. PINUS CONTORTA, var. MURRAYANA.

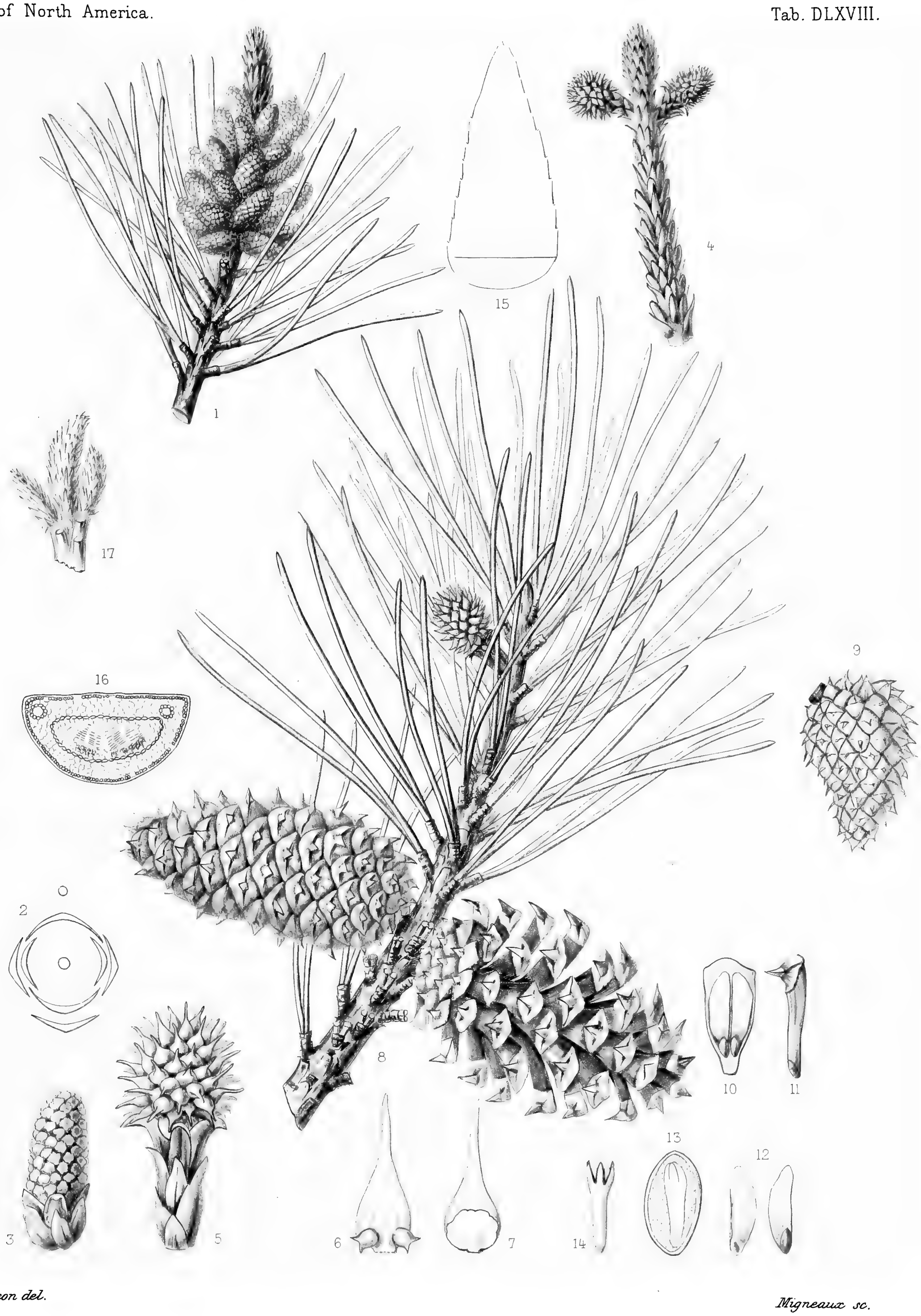
1. A branch with staminate flowers, natural size.
2. Diagram of the involucre of the staminate flower.
3. A staminate flower, enlarged.
4. An end of a branch with pistillate flowers, natural size.
5. A pistillate flower, enlarged.
6. A scale of a pistillate flower, upper side, with its ovules, enlarged.
7. A scale of a pistillate flower, lower side, with its bract, enlarged.
8. A fruiting branch, natural size.
9. A cone, from a tree of an intermediate form from the Siskiyou Mountains, Oregon, natural size.
10. A cone-scale, upper side, with its seeds, natural size.
11. A cone-scale, lateral view, natural size.
12. Seeds, natural size.
13. Vertical section of a seed, enlarged.
14. An embryo, enlarged.
15. Tip of a leaf, enlarged.
16. Cross section of a leaf, magnified fifteen diameters.
17. Winter branch-buds, natural size.



C.E. Faxon del. Migneaux sc.

PINUS CONTORTA, Loud.

A. Riocreux direx.t Imp. J. Taneur, Paris.



C.E.Faxon del. *Migneaux sc.*

PINUS CONTORTA, var. MURRAYANA, Engelm.

A.Riocreux direx.t *Imp. J. Taneur, Paris.*

PINUS SABINIANA.

Digger Pine. Bull Pine.

LEAVES in 3-leaved clusters, stout, pale blue-green, from 8 to 12 inches in length. Cones oval, acute, from 6 to 10 inches long, their scales produced into prominent knobs armed with stout straight or slightly incurved spines.

Pinus Sabiniana, Douglas, *Trans. Linn. Soc.* xvi. 747 (1833). — D. Don, *Lambert Pinus*, iii. t. — Forbes, *Pinetum Woburn.* 63, t. 23, 24. — Lawson & Son, *Agric. Man.* 353; *List No. 10, Abietineæ*, 33. — Hooker, *Fl. Bor.-Am.* ii. 162. — Antoine, *Conif.* 30, t. 11. — Hooker & Arnott, *Bot. Voy. Beechey*, 393. — Link, *Linnæa*, xv. 509. — Nuttall, *Sylva*, iii. 110, t. 113. — Spach, *Hist. Vég.* xi. 390. — De Chambray, *Traité Arb. Rés. Conif.* 347. — Endlicher, *Syn. Conif.* 159. — Knight, *Syn. Conif.* 30. — Lindley & Gordon, *Jour. Hort. Soc. Lond.* v. 216. — Dietrich, *Syn.* v. 398. — Planchon, *Fl. des Serres*, ix. 275, t. 964. — Carrière, *Traité Conif.* 334. — Torrey & Gray, *Pacific R. R. Rep.* ii. 130. — J. M. Bigelow, *Pacific R. R. Rep.* iv. pt. v. 25. — Torrey, *Pacific R. R. Rep.* iv. pt. v. 141; *Bot. Mex. Bound. Surv.* 210, t. 57; *Ives' Rep.* pt. iv. 28. — Courtin, *Fam. Conif.* 80. — Newberry, *Pacific R. R. Rep.* vi. pt. iii. 39, 90, f. 13. — Gordon, *Pinetum*, 208. — Walpers, *Ann.* v. 799. — Bolander, *Proc. Cal. Acad.* iii. 226, 318. — Henkel & Hochstetter, *Syn. Nadelh.* 75. — Lawson, *Pinetum Brit.* i. 85, t. 11, t. 1–3. — (Nelson) Senilis, *Pinaceæ*, 129. — Hoopes, *Evergreens*, 121. — Sénéclauze, *Conif.* 129. — Parlatore, *De Candolle Prodr.* xvi. pt. ii. 391. — K. Koch, *Dendr.* ii. pt. ii. 312. — Engelmann, *Rothrock Wheeler's Rep.* vi. 375; *Trans. St. Louis Acad.* iv. 182. — Brewer & Watson, *Bot. Cal.* ii. 127. — Veitch, *Man. Conif.* 169. — Kellogg, *Forest Trees of California*, 55. — Sargent, *Forest Trees N. Am.* 10*th Census U. S.* ix. 195. — Lauche, *Deutsche Dendr.* ed. 2, 111 — Lemmon, *Rep. California State Board Forestry*, ii. 75, 105, t. (*Pines of the Pacific Slope*); *West-American Cone-Bearers*, 39. — Steele, *Proc. Am. Pharm. Assoc.* 1889, 241 (*The Pines of California*). — Mayr, *Wald. Nordam.* 277, t. 7, f. — Beissner, *Handb. Nadelh.* 256. — Masters, *Jour. R. Hort. Soc.* xiv. 391. — Hansen, *Jour. R. Hort. Soc.* xiv. 391 (*Pinetum Danicum*). — Merriam, *North American Fauna*, No. 7, 339 (*Death Valley Exped.* ii.). — Coville, *Contrib. U. S. Nat. Herb.* iv. 223 (*Bot. Death Valley Exped.*). — Koehne, *Deutsche Dendr.* 35.

A tree, usually forty or fifty but occasionally eighty feet in height, with a trunk three or four feet in diameter divided generally fifteen or twenty feet above the ground into three or four stout secondary stems; these spread at first at narrow angles, and then become erect and are clothed with short crooked branches which, pendent below and ascending toward the summit of the tree, form an open round-topped head remarkable among Pines for the sparseness of its foliage. The bark of the trunk is from an inch and a half to two inches in thickness, dark brown slightly tinged with red, or nearly black, and deeply and irregularly divided into great thick rounded connected ridges covered with small closely appressed scales. The winter branch-buds are oblong-ovate, acute and abruptly contracted at the apex into short points, the terminal bud, which varies from three quarters of an inch to nearly an inch in length, being about twice as large as the lateral buds; they are covered with lanceolate light chestnut-brown lustrous scales more or less fringed on the scarious margins and soon deciduous, their thickened bases roughening the branches for many years; these are stout and glabrous, and in their first year are pale glaucous blue, becoming dark brown or nearly black during their second season. The leaves are borne in clusters of two, with lustrous pale chestnut-brown sheaths at first an inch in length and after the first season thick, close and firm, nearly black, and not more than half an inch long, falling with the leaves, usually in their third and fourth years; the leaves are acute with long slender callous tips, sharply and coarsely serrate toward the apex, mostly entire below, flexible, pendent, pale blue-green, from eight to twelve inches long and about one sixteenth of an inch wide; they are stomatiferous with many rows of conspicuous stomata on each face, and contain two or three parenchymatous resin

ducts surrounded with strengthening cells, which also occur under the epidermis, usually in a single layer.[1] The staminate flowers, which are produced in elongated spikes, are oblong and nearly an inch in length, with yellow anthers terminating in semiorbicular dentate crests, and are surrounded by involucres of from ten to fifteen bracts, those of the exterior pair being minute. The pistillate flowers are borne on stout glaucous peduncles which at first spread from the stem and then ascend and bend inward and are from an inch and a half to two inches long and covered by ovate acute light chestnut-brown bracts; they are oblong-obovate, about half an inch long and a third of an inch thick, with ovate dark purple glaucous scales gradually narrowed into long slender incurved points. The young cones soon become reflexed, and during their first winter and the following spring they are subglobose or oblong, about an inch and a half in length, with pale glaucous much thickened scales, flattened and straight or incurved at the apex, which is furnished with a short stout sharp tip; and when fully grown in the autumn they are oblong-ovate, full and rounded below, pointed, light red-brown, from six to ten inches long and from four to six inches broad, with thin and slightly concave scales about an inch wide at the rounded apex, their exposed portions being conspicuously transversely keeled and narrowed into prominent flattened knobs which are erect or incurved above the middle of the cone, strongly reflexed below, and armed with short sharp hooked spur-like incurved spines; the cones ripen in the autumn and gradually lose their seeds, often remaining on the branches for several years. The seeds are oblong, full and rounded below, somewhat compressed toward the apex, about three quarters of an inch long and a third of an inch wide, and dark brown or nearly black, with a thick hard coat produced into narrow lateral ridges which are broadest above the middle of the seed, a resinous oily kernel, and an embryo with fifteen or sixteen cotyledons; they are inclosed by their wings, which are much thickened on the inner rim, obliquely rounded at the broad apex, and about a third of an inch longer than the seeds.

Pinus Sabiniana, growing singly or in small groups, is scattered over the dry foothills of western California, ranging from about five hundred up to four thousand feet above the sea-level and from the southern slopes of the great cross range which forms the northern barrier of the state southward to the Tehachapi Mountains and the Sierra de la Liebre;[2] it is most abundant and grows to its largest size on sun-baked slopes in the middle of the state, where at an elevation of about two thousand feet, mixed with *Quercus Douglasii* and great thickets of Ceanothus and Manzanita, it is often the most conspicuous feature of the vegetation, differing from all other Pines in its habit and in its long pale blue tufted foliage so thin and sparse that the great branches loaded with massive cones stand out in bold relief against the sky.

The wood of *Pinus Sabiniana* is light, soft, not strong, coarse-grained, brittle and not durable; it is light brown or red, with thick yellow or nearly white sapwood and contains broad very resinous conspicuous bands of small summer cells, few large prominent resin passages, and numerous obscure medullary rays. The specific gravity of the absolutely dry wood is 0.4840, a cubic foot weighing 30.16 pounds.[3]

Abietene,[4] a hydrocarbon, is obtained by distilling the resinous juices of *Pinus Sabiniana*. The

[1] Coulter & Rose, *Bot. Gazette*, xi. 307.

[2] Merriam, *North American Fauna*, No. 7, 339 (*Death Valley Exped.* ii.). — Coville, *Contrib. U. S. Nat. Herb.* iv. 223 (*Bot. Death Valley Exped.*). — S. B. Parish, *Zoë*, iv. 351.

[3] *Pinus Sabiniana* grows rapidly, especially during its early years. The log specimen in the Jesup Collection of North American Woods in the American Museum of Natural History, New York, is twenty-three inches in diameter inside the bark, with fifty-one layers of annual growth, the sapwood being three and three quarters inches thick and twenty-two years old.

[4] Abietene is a nearly colorless mobile aromatic liquid with the odor of oil of oranges. It is an article of commerce in San Francisco, being sold under the name of abietene, evasine, aurantine, and theoline, and used for removing grease spots and other stains from clothing. It has been employed as an insecticide and is believed to possess powerful anæsthetic properties, although its medicinal value has probably been overestimated. (See Wenzell, *Am. Jour. Pharm.* xliv. 97 [*Abietene, a New Hydrocarbon*]. — Sadtler, *Am. Jour. Pharm.* li. 96, 293. — Thorpe, *Jour. Chem. Soc.* xxxv. 296 [*On Heptane from Pinus Sabiniana*]; *Dictionary of Applied Chemistry*, i. 2. — Thorpe & Schorlemer, *Jour. Chem. Soc.* xxxviii. 213. — Trimble, *Garden and Forest*, x. 202.)

large sweet slightly resinous seeds were an important article of food for the Indians of California, who gathered them in great quantities.[1]

Pinus Sabiniana was discovered in 1831 on the mountains near Monterey by David Douglas, who introduced it the following year into Europe and named it in honor of Joseph Sabine,[2] secretary of the Horticultural Society of London, in whose garden at Chiswick it was first cultivated.[3] *Pinus Sabiniana* may be occasionally seen in European collections, where it has attained considerable size,[4] but the rich soil of the California foothills and the long, hot, dry summers of California are evidently required to develop its characteristic and peculiar beauties.

[1] Newberry, *Popular Science Monthly*, xxxii. 35 (*Food and Fibre Plants of the North American Indians*). — Muir, *The Mountains of California*, 148.

[2] Joseph Sabine (1770–1837) was born in London, and, although a lawyer by profession, devoted much attention to natural history. In 1810 he was made secretary of the Horticultural Society of London, filling this position during the years when the society was more active and successful in introducing and cultivating exotic plants in its gardens at Hammersmith and Chiswick, established by him, than at any other period of its history. He was the author of a number of papers on botany and zoölogy published in the Transactions of the Horticultural Society and of the Linnæan Society, including several devoted to the early history of the Chrysanthemum. *Sabinea*, a genus of trees and shrubs of the Pea family, natives of the West Indies, was named for him by De Candolle.

[3] Loudon, *Arb. Brit.* iv. 2246, f. 2138–2147.

[4] Fowler, *Gard. Chron.* 1872, 1326. — *Gard. Chron.* ser. 3, v. 44, f. 6.

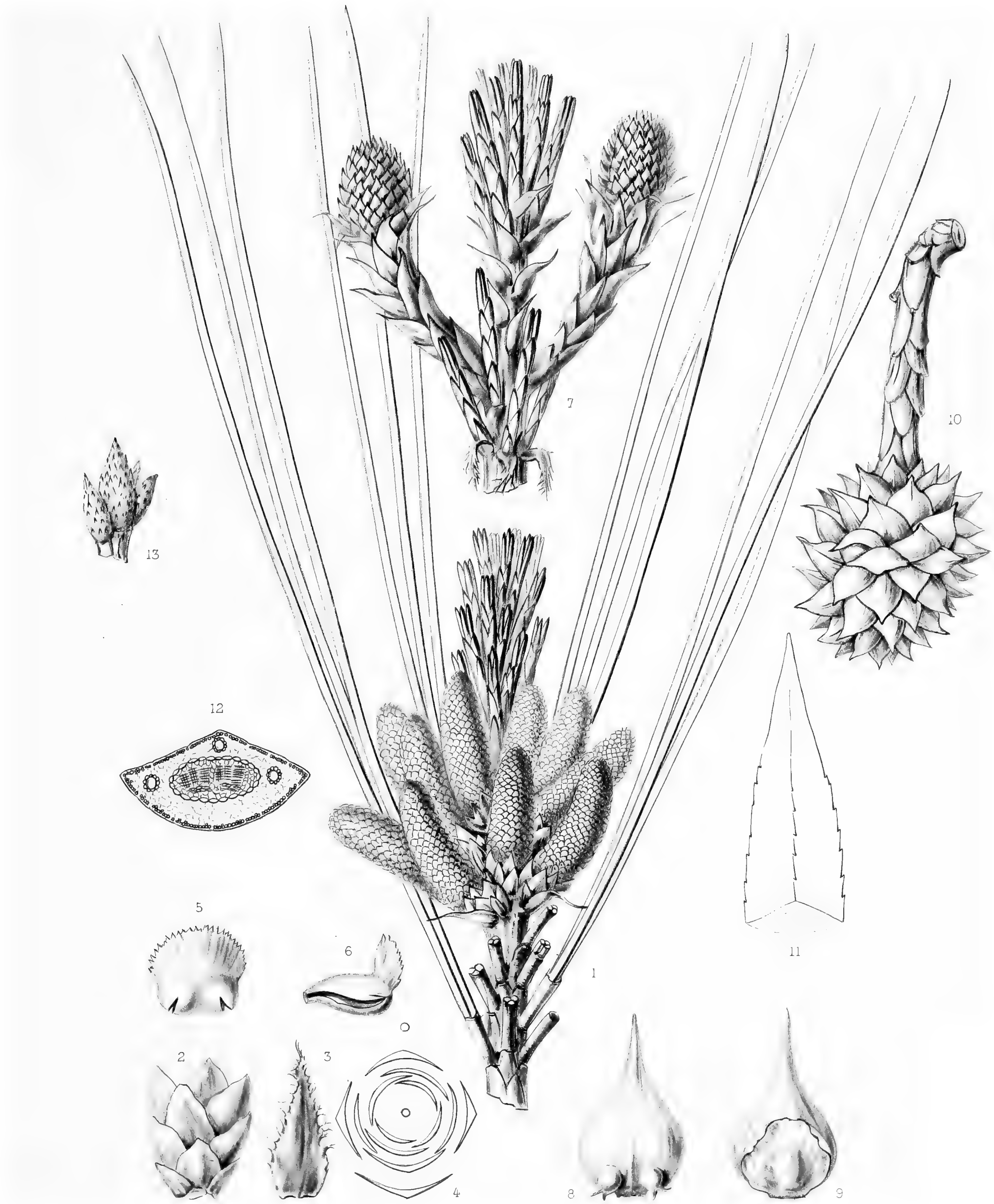
EXPLANATION OF THE PLATES.

Plate DLXIX. Pinus Sabiniana.

1. A branch with staminate flowers. natural size.
2. An involucre of a staminate flower, enlarged.
3. A bract of a staminate flower, enlarged.
4. Diagram of the involucre of the staminate flower.
5. An anther, front view, enlarged.
6. An anther, side view, enlarged.
7. End of a branch with pistillate flowers, natural size.
8. A scale of a pistillate flower, upper side, with its ovules, enlarged.
9. A scale of a pistillate flower, lower side, with its bract, enlarged.
10. A cone one year old, natural size.
11. Tip of a leaf, enlarged.
12. Cross section of a leaf, magnified fifteen diameters.
13. Winter branch-buds, natural size.

Plate DLXX. Pinus Sabiniana.

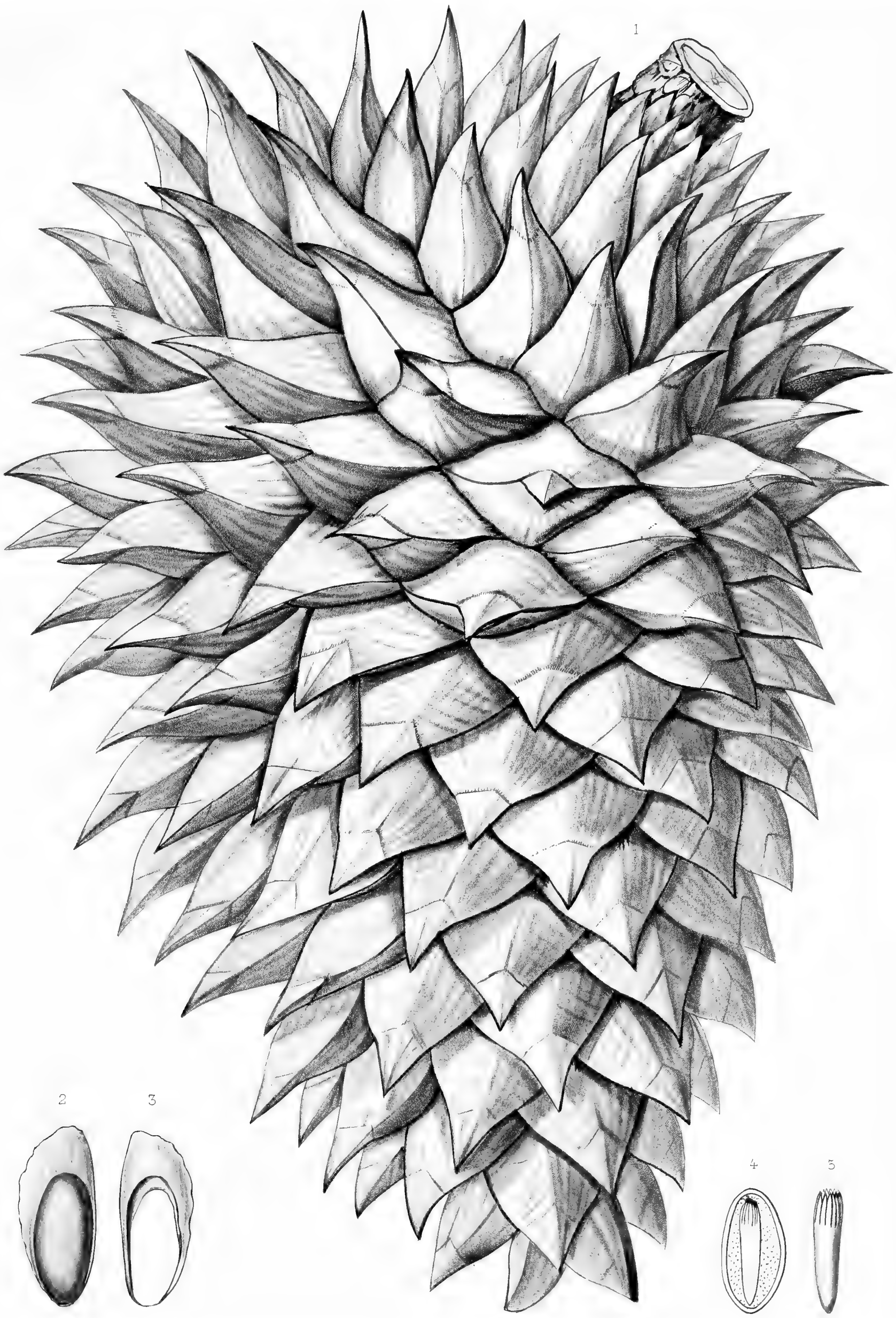
1. A cone, natural size.
2. A seed, natural size.
3. A wing of a seed, natural size.
4. Vertical section of a seed, natural size.
5. An embryo, enlarged.



C E. Faxon del. *Em. Himely sc.*

PINUS SABINIANA, Dougl.

A. Riocreux direx.t *Imp. J. Taneur, Paris.*



C.E Faxon del. Em. Himely sc.

PINUS SABINIANA, Dougl.

A. Riocreux direx.t Imp.. J. Taneur, Paris.

PINUS COULTERI.

Pitch Pine.

LEAVES in 3-leaved clusters, stout, rigid, dark blue-green, from 6 to 12 inches in length. Cones oval, acute, from 10 to 14 inches long, their scales much thickened into stout elongated umbos armed with thick spur-like incurved spines.

Pinus Coulteri, D. Don, *Trans. Linn. Soc.* xvii. 440 (1837). — Forbes, *Pinetum Woburn.* 67, t. 25, 26. — Antoine, *Conif.* 31, t. 12, 13. — Link, *Linnæa*, xv. 510. — Hooker & Arnott, *Bot. Voy. Beechey*, 393. — Nuttall, *Sylva*, iii. 112. — Endlicher, *Syn. Conif.* 160. — Lawson & Son, *List No. 10, Abietineæ*, 31. — Dietrich, *Syn.* v. 398. — Carrière, *Traité Conif.* 335. — Torrey, *Ives' Rep.* pt. iv. 28. — Courtin, *Fam. Conif.* 77. — Henkel & Hochstetter, *Syn. Nadelh.* 76. — Bolander, *Proc. Cal. Acad.* iii. 318. — Sénéclauze, *Conif.* 125. — Parlatore, *De Candolle Prodr.* xvi. pt. ii. 392. — Gordon, *Pinetum*, ed. 2, 266. — Engelmann, *Trans. St. Louis Acad.* iv. 182; *Brewer & Watson Bot. Cal.* ii. 127. — Lawson, *Pinetum Brit.* i. 23, f. 1–5. — Kellogg, *Trees of California*, 59. — Sargent, *Forest Trees N. Am. 10th Census U. S.* ix. 195. — Lauche, *Deutsche Dendr.* ed. 2, 111. — Schübeler, *Virid. Norveg.* i. 393. — Lemmon, *Rep. California State Board Forestry*, ii. 75, 103, t. (*Pines of the Pacific Slope*); *West-American Cone-Bearers*, 38, t. 6. — Steele, *Proc. Am. Pharm. Assoc.* 1889, 240 (*The Pines of California*). — Mayr, *Wald. Nordam.* 332, t. 7, f. — Beissner, *Handb. Nadelh.* 257. — Masters, *Jour. R. Hort. Soc.* xiv. 227. — Hansen, *Jour. R. Hort. Soc.* xiv. 357 (*Pinetum Danicum*). — Koehne, *Deutsche Dendr.* 35.

Pinus macrocarpa, Lindley, *Bot. Reg.* xxvi. Misc. 61 (1840). — Knight, *Syn. Conif.* 30. — Lindley & Gordon, *Jour. Hort. Soc. Lond.* v. 216. — Gordon, *Pinetum*, 201. — (Nelson) Senilis, *Pinaceæ*, 117. — Hoopes, *Evergreens*, 115. — Veitch, *Man. Conif.* 166.

A tree, from fifty to seventy feet in height, with a trunk sometimes four feet in diameter, although generally smaller, and stout limbs covered with dark scaly bark, which are long and mostly pendulous below and short and ascending above, the whole forming a loose unsymmetrical and often exceedingly picturesque head of stout branches sweeping upward, and clothed at the extremities with great tufts of erect rigid leaves. The bark of the trunk is from an inch and a half to nearly two inches in thickness, dark brown or nearly black, and deeply divided into broad rounded connected ridges covered with thin closely appressed scales. The winter branch-buds are ovate, acute or abruptly contracted into short points, from an inch to an inch and a half long and from one half to two thirds of an inch broad, with lanceolate outer scales dark orange below, chestnut-brown above, scarious and fimbriate on the margins, and much narrower than the dark chestnut-brown scales of the inner ranks, which are often an inch long, and soon becoming reflexed and falling, leave their thickened persistent bases to roughen the branches for several years. The branchlets are often an inch in diameter, and when they first appear are dark orange-brown, but gradually growing darker, they sometimes become nearly black at the end of three or four years. The leaves are borne in clusters of three, with sheaths which at first are about an inch and a half in length, with thin light chestnut-brown lustrous scales scarious and fringed on the margins, and at maturity are thin, dark brown, half an inch long, loose and ragged above, and persistent with the leaves, which usually fall in their third or fourth season; the leaves are stout, rigid, serrulate above the middle, mostly entire below, acuminate with long callous points, dark blue-green, from six to twelve inches in length, and frequently an eighth of an inch in width, and contain two fibro-vascular bundles, from four to ten resin ducts variable in size, sometimes internal, and usually surrounded with strengthening cells, which also occur under the epidermis in many layers broken into thick bundles by the numerous bands of stomata which conspicuously mark the three faces of the leaf.[1] The staminate flowers, which are produced in crowded clusters, are

[1] Coulter & Rose, *Bot. Gazette*, xi. 306.

cylindrical and about an inch and a half long, with yellow anthers terminating in orbicular obscurely denticulate crests, and are surrounded by involucres of eight or ten bracts. The pistillate flowers are oblong-oval, and from one half to three quarters of an inch in length, with ovate dark reddish brown glaucous scales contracted into long incurved tips, and are raised on stout peduncles often an inch and a half long and covered by ovate acuminate scarious bracts. The young cones grow rapidly, soon becoming horizontal or pendent, and in the autumn they are oblong, full and rounded at the apex, about two inches long and an inch and a half thick, with broadly ovate incurved light yellow-brown scales rounded on the back and gradually narrówed into long rigid points; when fully grown a year later the cones are oval, acute, from ten to fourteen inches long, four or five inches thick, short-stalked and pendent, with thick wide scales which are rounded above, their exposed portions being much thickened into transversely flattened elongated knobs straight or curved backward, and terminating in robust flattened more or less incurved spines from half an inch to an inch and a half in length; they are light yellow-brown on the outer surface and dark dull purple on the covered parts of the scales, and, partly opening in the autumn and slowly losing their seeds, often remain for several years on the branches. The seeds are oval, compressed, half an inch long, from one quarter to one third of an inch wide, and dark chestnut-brown, with a thick coat produced into narrow lateral ridges; they contain a sweet oily albumen and an embryo with from eleven to fourteen cotyledons, and are surrounded by their wings, which are thickened on the inner rim, thin and firm above, broadest above the middle, oblique at the apex, nearly an inch longer than the seeds, about five eighths of an inch wide, and lustrous and light chestnut-brown, with dark longitudinal stripes.

Pinus Coulteri is scattered singly or in small groves through the coniferous forests on the dry slopes and ridges or the gravelly benches[1] of the coast ranges of California at elevations from three to six thousand feet above the sea from Mount Diabolo and the Santa Lucia Mountains to the Cuyamaca Mountains, being most abundant on the San Bernardino and San Jacinto ranges, growing to its largest size at elevations of about five thousand feet on their forest-clad ridges with *Pinus ponderosa*, *Pinus Lambertiana*, and *Abies concolor*, and on dry southern slopes, where it is smaller but more abundant, with *Pinus attenuata*.

The wood of *Pinus Coulteri* is light, soft, not strong, brittle, and coarse-grained; it is light red, with thick nearly white sapwood, and contains broad conspicuous very resinous bands of small summer cells, few large resin passages, and numerous prominent medullary rays. The specific gravity of the absolutely dry wood is 0.4133, a cubic foot weighing 25.76 pounds.[2] It is occasionally used for fuel.

The seeds were gathered and eaten by the Indians of southern California.[3]

Pinus Coulteri was discovered in 1832 by Thomas Coulter[4] on the Santa Lucia Mountains, and was introduced into English gardens, probably in the same year, by David Douglas.[5] Valuable as an ornamental plant only for the beauty of its massive cones, which are heavier than those of any other Pine-tree, *Pinus Coulteri* is perfectly hardy in western and central Europe, where it has already grown to a large size and produced its fruit.[6]

[1] S. B. Parish, *Zoë*, iv. 351.

[2] *Pinus Coulteri* grows rapidly, at least while young. The log specimen in the Jesup Collection of North American Woods, in the American Museum of Natural History, New York, is twenty and one half inches in diameter inside the bark, and only one hundred and eleven years old. The sapwood of this specimen is six and a quarter inches in thickness, with seventy-nine layers of annual growth.

[3] Newberry, *Popular Science Monthly*, xxxii. 35 (*Food and Fibre Plants of the North American Indians*).

[4] See iii. 84.

[5] Loudon, *Arb. Brit.* iv. 2250, f. 2144, 2147.

[6] *Gard. Chron.* n. ser. xxiii. 415, f. 74; 478; ser. 3, iv. 764, f. 109.

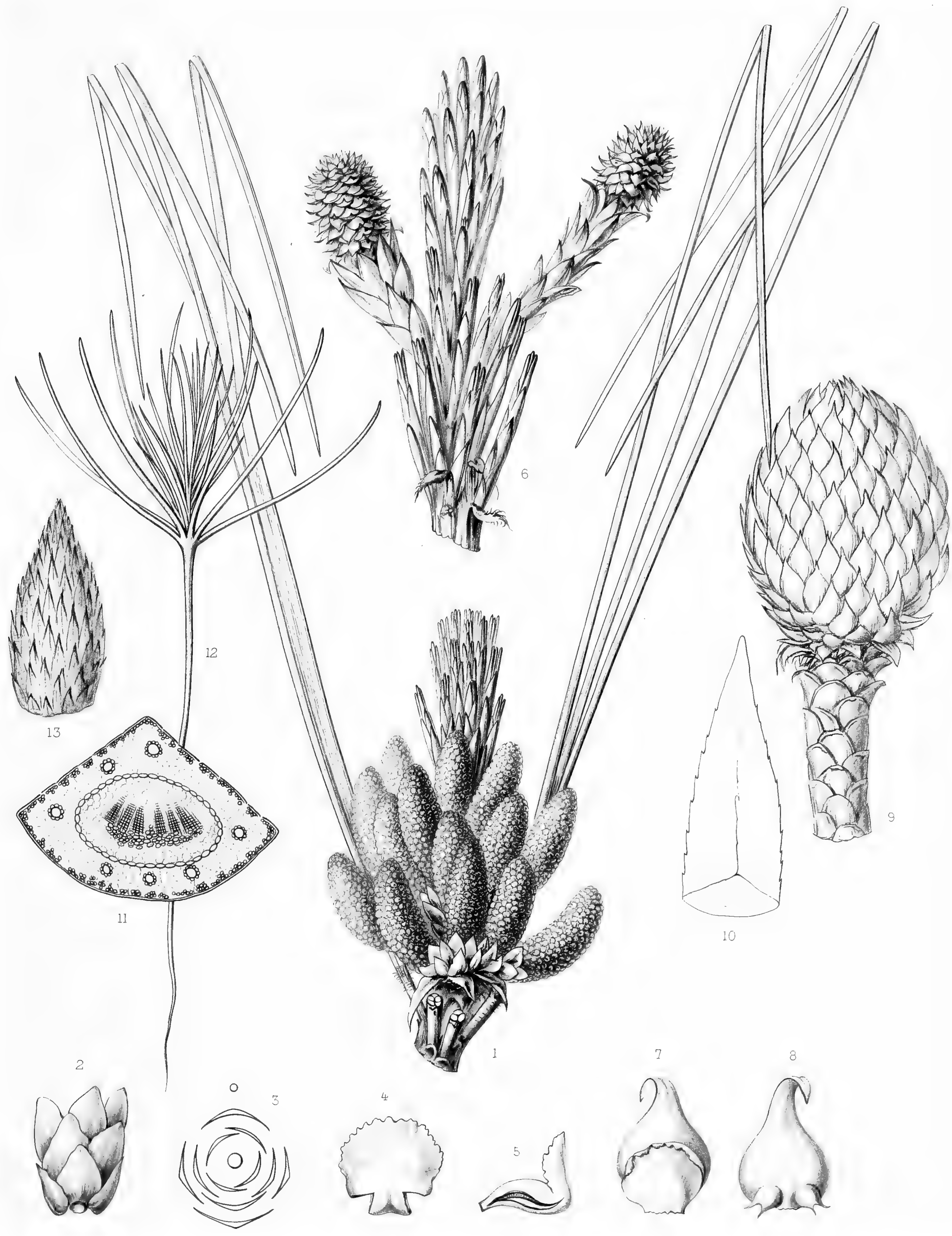
EXPLANATION OF THE PLATES.

Plate DLXXI. Pinus Coulteri.

1. A branch with staminate flowers, natural size.
2. An involucre of a staminate flower, enlarged.
3. Diagram of the involucre of the staminate flower.
4. An anther, front view, enlarged.
5. An anther, side view, enlarged.
6. An end of a branch with pistillate flowers, natural size.
7. A scale of a pistillate flower, lower side, with its bract, enlarged.
8. A scale of a pistillate flower, upper side, with its ovules, enlarged.
9. A cone, one year old, natural size.
10. Tip of a leaf, enlarged.
11. Cross section of a leaf, magnified fifteen diameters.
12. A seedling plant, natural size.
13. A winter branch-bud, natural size.

Plate DLXXII. Pinus Coulteri.

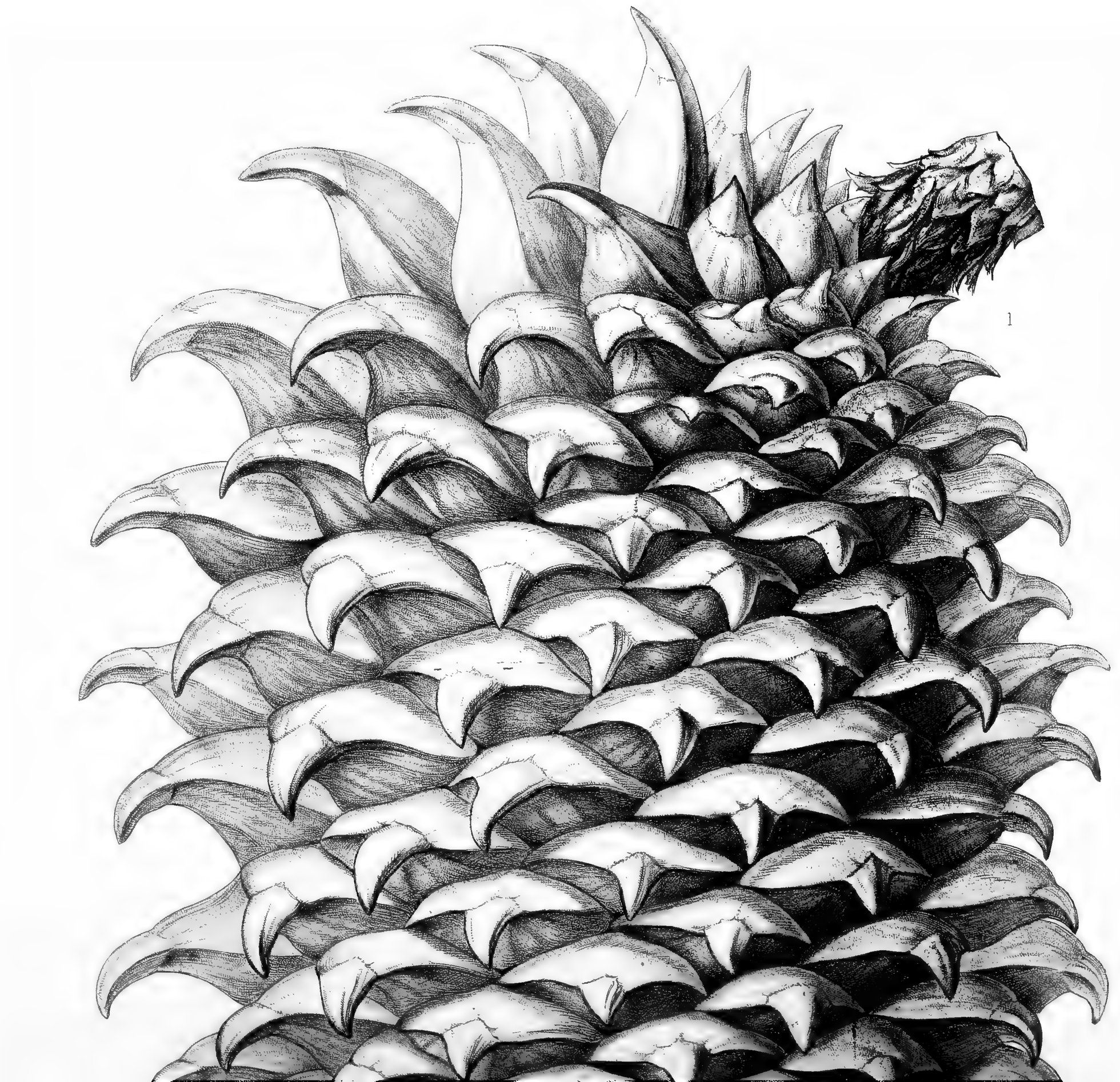
1. A cone, natural size.
2. Seeds, natural size.
3. A seed-wing, natural size.
4. Vertical section of a seed, enlarged.
5. An embryo, enlarged.

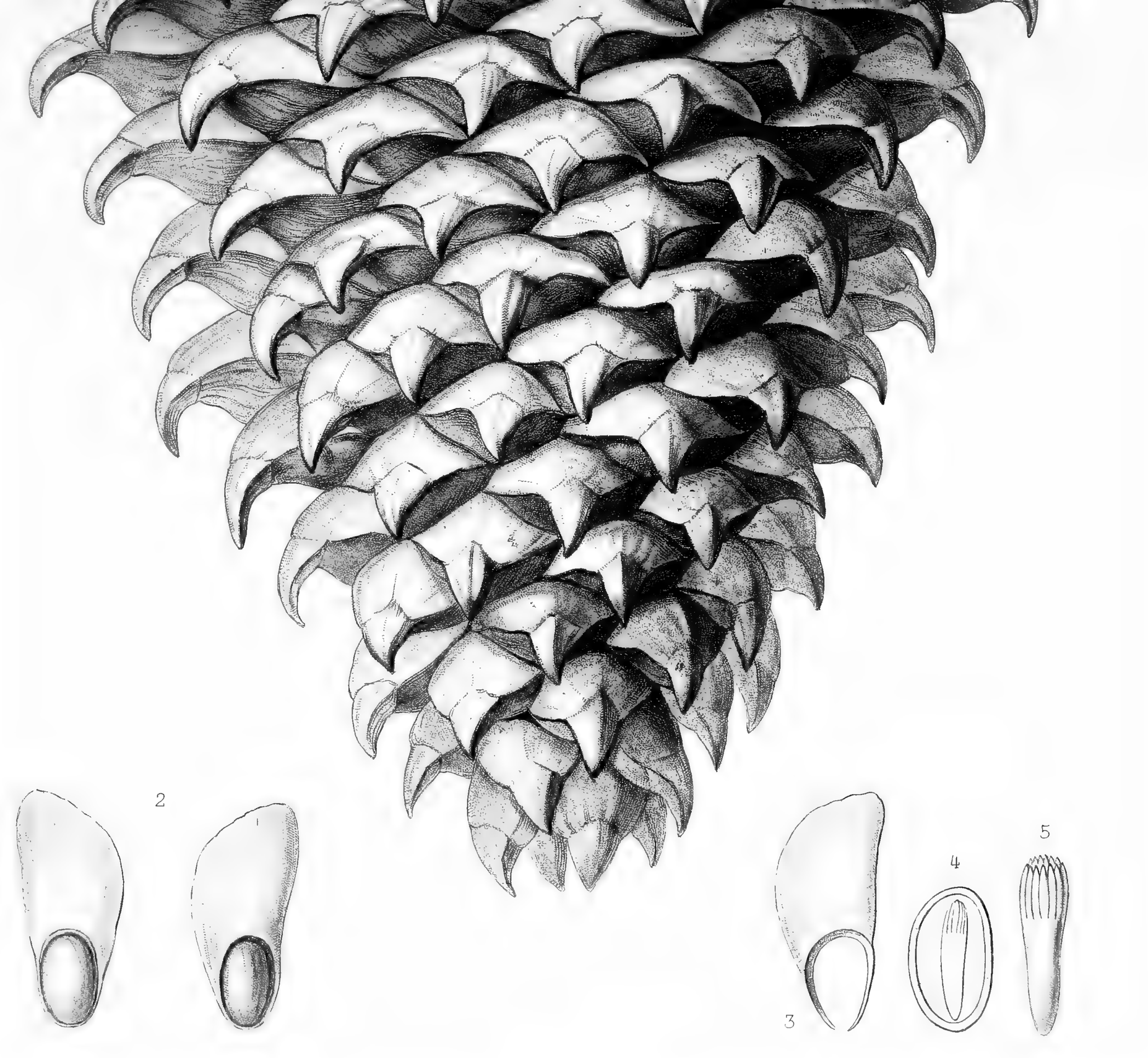


C.E.Faxon del. *Rapine sc.*

PINUS COULTERI, D. Don.

A.Riocreux direx.t *Imp. J. Taneur, Paris.*





C.E. Faxon del.

Rapine sc.

PINUS COULTERI D. Don.

A. Riocreux direx.t

Imp. J. Taneur, Paris.

PINUS RADIATA.

Monterey Pine.

LEAVES usually in 3-leaved clusters, slender, bright green, from 4 to 6 inches in length. Cones oval, oblique, from 3 to 6 inches long, their scales mammillate on the outer side, especially below the middle, furnished with minute incurved prickles.

Pinus radiata, D. Don, *Trans. Linn. Soc.* xvii. 441 (1836). — Lambert, *Pinus*, iii. t. — Loudon, *Arb. Brit.* iv. 2270, f. 2182. — Antoine, *Conif.* 33, t. 14, f. 3. — Hooker & Arnott, *Bot. Voy. Beechey*, 392, 393 (in part). — Nuttall, *Sylva*, iii. 116. — Endlicher, *Syn. Conif.* 161. — Hartweg, *Jour. Hort. Soc. Lond.* iii. 226. — Lawson & Son, *List No. 10, Abietineæ*, 33. — Gordon, *Jour. Hort. Soc. Lond.* iv. 214, f.; *Fl. des Serres*, vi. 43, f.; *Pinetum*, 206. — Knight, *Syn. Conif.* 30. — Lindley & Gordon, *Jour. Hort. Soc. Lond.* v. 216. — Dietrich, *Syn.* v. 398. — Carrière, *Traité Conif.* 337. — Courtin, *Fam. Conif.* 79. — (Nelson) Senilis, *Pinaceæ*, 127. — Hoopes, *Evergreens*, 118. — Sénéclauze, *Conif.* 128. — K. Koch, *Dendr.* ii. pt. ii. 307. — Lauche, *Deutsche Dendr.* ed. 2, 110. — Sudworth, *Rep. U. S. Dept. Agric.* 1892, 328. — Lemmon, *West-American Cone-Bearers*, 40.

? Pinus Californiana, Loiseleur, *Nouveau Duhamel*, v. 243 (1812?). — Loudon, *Arb. Brit.* iv. 2268. — Nuttall, *Sylva*, iii. 117.

Pinus adunca, Poiret, *Lamarck Dict.* Suppl. iv. 418 (1816).

Pinus insignis, Loudon, *Arb. Brit.* iv. 2265, f. 2170–2172 (1838). — Forbes, *Pinetum Woburn.* 51, t. 18. — Antoine, *Conif.* 27, t. 8, f. 1. — Hooker & Arnott, *Bot. Voy. Beechey*, 393. — Spach, *Hist. Vég.* xi. 389. — Bentham, *Bot. Voy. Sulphur*, 55. — Endlicher, *Syn. Conif.* 163. — Nuttall, *Sylva*, iii. 115. — Knight, *Syn. Conif.* 30. — Lawson & Son, *List No. 10, Abietineæ*, 31. — Lindley & Gordon, *Jour. Hort. Soc. Lond.* v. 217. — Dietrich, *Syn.* v. 398. — Carrière, *Traité Conif.* 339. — J. M. Bigelow, *Pacific R. R. Rep.* iv. pt. v. 25. — Torrey, *Pacific R. R. Rep.* iv. pt. v. 141; *Bot. Mex. Bound. Surv.* 209, t. 55; *Ives' Rep.* pt. iv. 28. — Newberry, *Pacific R. R. Rep.* vi. pt. iii. 90. — Gordon, *Pinetum*, 197. — Courtin, *Fam. Conif.* 78. — A. Murray, *Edinburgh New Phil. Jour.* n. ser. xi. 222; *Trans. Bot. Soc. Edinburgh*, vi. 347. — Henkel & Hochstetter, *Syn. Nadelh.* 69. — Bolander, *Proc. Cal. Acad.* iii. 262, t. 317. — (Nelson) Senilis, *Pinaceæ*, 114. — Hoopes, *Evergreens*, 143. — Sénéclauze, *Conif.* 126. — Parlatore, *De Candolle Prodr.* xvi. pt. ii. 395. — Lawson, *Pinetum Brit.* i. 37, t. 1, 5, f. 1–14. — Engelmann, *Trans. St. Louis Acad.* iv. 182; *Brewer & Watson Bot. Cal.* ii. 127. — Veitch, *Man. Conif.* 163, f. 39. — Kellogg, *Trees of California*, 60. — Sargent, *Forest Trees N. Am. 10th Census U. S.* ix. 196. — Lemmon, *Rep. California State Board Forestry*, ii. 76, 112, t. (*Pines of the Pacific Slope*). — Steele, *Proc. Am. Pharm. Assoc.* 1889, 242 (*The Pines of California*). — Mayr, *Nordam. Holz.* 273, t. 7, f. — Beissner, *Handb. Nadelh.* 271. — Masters, *Jour. R. Hort. Soc.* xiv. 230. — Hansen, *Jour. R. Hort. Soc.* xiv. 364 (*Pinetum Danicum*). — Koehne, *Deutsche Dendr.* 34.

Pinus rigida? Hooker & Arnott, *Bot. Voy. Beechey*, 160 (not Miller) (1833).

Pinus Sinclairii, Hooker & Arnott, *Bot. Voy. Beechey*, 392, 393, t. 93 (in part) (1841). — Nuttall, *Sylva*, iii. 141.

Pinus tuberculata, D. Don, *Trans. Linn. Soc.* xvii. 441 (1836); *Lambert Pinus*, iii. t. — Loudon, *Arb. Brit.* iv. 2270, f. 2181. — Antoine, *Conif.* 33, t. 14, f. 2. — Hooker & Arnott, *Bot. Voy. Beechey*, 394. — Endlicher, *Syn. Conif.* 162. — Carrière, *Traité Conif.* 338 (in part). — Parlatore, *De Candolle Prodr.* xvi. pt. ii. 394 (in part).

Pinus Californica, Hooker & Arnott, *Bot. Voy. Beechey*, 393 (1841). — Endlicher, *Syn. Conif.* 162. — Lawson & Son, *List No. 10, Abietineæ*, 31. — Dietrich, *Syn.* v. 398. — Carrière, *Traité Conif.* 353. — Courtin, *Fam. Conif.* 77. — Sénéclauze, *Conif.* 124.

Pinus insignis macrocarpa, Hartweg, *Jour. Hort. Soc. Lond.* iii. 226 (not *Pinus macrocarpa*, Lindley) (1846). — Carrière, *Traité Conif.* ed. 2, 440.

Pinus Sinclairiana, Carrière, *Traité Conif.* 355 (1855).

Pinus insignis, var. (a) **radiata**, Lemmon, *Rep. California State Board Forestry*, ii. 76, 114 (*Pines of the Pacific Slope*) (1888).

Pinus insignis, var. (b) **lævigata**, Lemmon, *Rep. California State Board Forestry*, ii. 76, 114 (*Pines of the Pacific Slope*) (1888).

Pinus radiata, var. (a) **tuberculata**, Lemmon, *West-American Cone-Bearers*, 41 (1895).

A tree, from eighty to one hundred feet in height, with a tall trunk usually two or three but occasionally five or six feet in diameter, and thick spreading branches which form an irregular narrow open round-topped head. The bark of the trunk is from an inch and a half to two inches in thickness,

dark red-brown, and deeply divided into broad flat ridges broken on the surface into thick appressed plate-like scales. The winter branch-buds are ovate, acute, from one third to one half of an inch long, and one quarter of an inch thick, with acuminate bright chestnut-brown scales only slightly fimbriated on the margins, their thickened persistent bases roughening for years the slender branchlets, which when they first appear are light or dark orange-color, often covered with a glaucous bloom, and gradually grow dark red-brown. The leaves are borne in clusters of three or rarely of two, with persistent sheaths which at first are thin, loose, scarious, and from one half to three quarters of an inch long, but soon, losing their inner scales, become thick, firm, dark brown, and about a quarter of an inch in length; they are closely serrate, acute with short callous tips, bright rich green, from four to six inches long, about one twenty-fourth of an inch wide, and stomatiferous on the three faces; they contain two fibro-vascular bundles and usually a single parenchymatous resin duct surrounded by strengthening cells, which also occur generally in a single interrupted layer under the epidermis;[1] they mostly fall during their third season. The staminate flowers are produced in dense spikes from an inch to an inch and a half long, and are oblong and half an inch in length, with yellow anthers terminating in orbicular denticulate crests, and ten involucral bracts. The pistillate flowers are lateral, clustered, raised on short stout peduncles covered by broadly ovate acute chestnut-brown bracts scarious on the margins, and are dark purple, with ovate scales gradually contracted into slender incurved tips, and conspicuous orbicular bracts. The cones at the end of their first year are ovate, horizontal, or slightly ascending, purple, more or less covered with a glaucous bloom, armed with minute incurved spines, from three quarters of an inch to an inch long and about two thirds of an inch wide; and when fully grown in the autumn they are short-stalked, deflexed, oval, pointed at the apex, very oblique at the base by a greater development of the scales on the outer than on the inner side, from three to five inches long and from two to three inches thick, with thin nearly flat scales deep purple below and rounded at the apex, their exposed portions, which are much thickened and mammillate toward the base on the outer side of the cone, and are thin and obscurely transversely keeled on its inner side and at its apex, terminating in small dark four-sided umbos furnished with minute thickened incurved or straight prickles; the cones are deep chestnut-brown, lustrous, and persistent, often remaining closed on the branches for many years. The seeds are oval, compressed, about a quarter of an inch long, with a thin brittle tuberculate black coat and an embryo with from five to seven cotyledons; their wings are thin, light brown, longitudinally striped, broadest above the middle, gradually narrowed and oblique at the apex, an inch long and about a quarter of an inch wide.

Pinus radiata, which is most abundant and grows to its largest size on Point Pinos south of the Bay of Monterey, inhabits a narrow strip of the California coast from Pescadero to the shores of San Simeon Bay, forming an interrupted forest extending inland from the summits of sea cliffs and the margins of beaches and sand dunes for a distance only of a few miles, and grows also in a peculiar form[2] on the islands of Santa Rosa and Santa Cruz of the Santa Barbara group, and on Guadalupe off the coast of Lower California, on which great forests of this tree formerly existed at elevations between two and four thousand feet above the sea-level.

The wood of *Pinus radiata* is light, soft, not strong, brittle, and close-grained; it is light brown, with thick nearly white sapwood, and contains narrow conspicuous resinous bands of small summer cells and inconspicuous medullary rays. The specific gravity of the absolutely dry wood is 0.4574, a cubic

[1] Coulter & Rose, *Bot. Gazette*, xi. 307.

[2] *Pinus radiata*, var. (b) *binata*, Lemmon, *West-American Cone-Bearers*, 42 (1895).

Pinus insignis, var. *binata*, Watson, *Proc. Am. Acad.* xi. 119 (1876). — Engelmann, *Brewer & Watson Bot. Cal.* ii. 128. — Sargent, *Forest Trees N. Am.* 10*th Census U. S.* ix. 196. — Masters, *Jour. R. Hort. Soc.* xiv. 231. — Franceschi, *Zoë*, iv. 138.

The insular form of *Pinus radiata*, first discovered by Dr. Edward Palmer in 1875 on the island of Guadalupe, where it is a large tree usually about seventy feet high, with wide-spreading branches, differs only in the number of the leaves, which are usually produced in clusters of two and sometimes on the same branch in clusters of two and of three, the cones appearing identical with those borne by the mainland tree. In June, 1888, this form was found on Santa Rosa by Mr. T. S. Brandegee (*Proc. Cal. Acad.* ser. 2, i. pt. ii. 217).

foot weighing 28.50 pounds. Formerly occasionally manufactured into lumber, it is now only used as fuel.

Pinus radiata was introduced into English gardens in 1833 by David Douglas, who found it near Monterey.[1] The light green of its dense foliage and its compact bushy habit while young at once attracted the attention of planters; and one of the least beautiful of North American Pines as it grows naturally, it has been extensively used for the decoration of parks in western and southern Europe, where, although rather tender except in favorable positions, it has already attained a great size and produced noble specimens, with wide-spreading lower branches, often resting on the ground, and shorter and erect upper branches forming dense masses of bright green foliage.[2] Easily and cheaply raised from seeds and growing with remarkable rapidity,[3] the Monterey Pine has been more generally planted in the coast region of the Pacific states from Vancouver Island southward than any other conifer with the exception of the Monterey Cypress, and it has been successfully introduced into the southeastern states, Mexico, Australia,[4] New Zealand, and other regions with temperate climates.

[1] Colligon, a gardener who accompanied La Pérouse on his ill-fated voyage of discovery, in 1787 sent to the Muséum d'Histoire Naturelle in Paris a Pine cone believed to have been gathered at Monterey, and said to resemble that of the Maritime Pine of Europe, but with the large seeds of *Pinus Cembra*. Twelve plants were raised from these seeds, and were described about 1812 by Loiseleur de Longchamps as *Pinus Californiana*. Judging by the locality where Colligon is supposed to have obtained his cone, it might well belong to the Monterey Pine; but the large seeds suggest another species, while the description of the plants raised from them might apply as well to several other trees as to this. It is necessary, therefore, to pass over what is perhaps the earliest name of this tree as well as the specific name, *adunca*, published in 1816, and supposed to refer to the cultivated plants raised from Colligon's seeds. (See *Nouveau Duhamel*, v. 243. — Lemmon, *Erythea*, i. 224.)

Pinus Sinclairii (Hooker & Arnott, *Bot. Voy. Beechey*, 392, t. 93), published in 1840 or 1841, was founded on a cone of *Pinus Montezumæ* from Tepic in Mexico and on foliage of *Pinus radiata*, while *Pinus radiata* of these authors is made up from the leaves of the former species and the cone of the latter. (See Engelmann, *Brewer & Watson Bot. Cal.* ii. 128.)

[2] Fowler, *Gard. Chron.* 1872, 1070. — *Gard. Chron.* n. ser. ix. 108, f. 22, 23; xviii. 492, ser. 3, ix. 337, f. 77; xiv. 725, 757, 808; xv. 21. — *The Garden*, xxxvi. 47, f. — J. G. Jack, *Garden and Forest*, vi. 14.

[3] *Pinus radiata* grows with great rapidity even in the most exposed positions and on apparently barren soil. The log specimen in the Jesup Collection of North American Woods in the American Museum of Natural History, New York, is seventeen and three quarters inches in diameter inside the bark, and twenty-eight years old; the sapwood of this specimen is six and one eighth inches thick, with eighteen layers of annual growth. Many of the trees covering that part of Point Pinos called Pacific Grove had trunk diameters of two feet in 1888, when they were only from twenty to thirty years old; and the largest trees on this point, with trunks from four to six feet in diameter, are not more than one hundred years old, some of their layers of annual growth being an inch in thickness. (See Lemmon, *Rep. California State Board of Forestry*, ii. 114 [*Pines of the Pacific Slope*].)

[4] F. Mueller, *Select Plants Readily Eligible for Industrial Culture or Naturalization in Victoria*, 175.

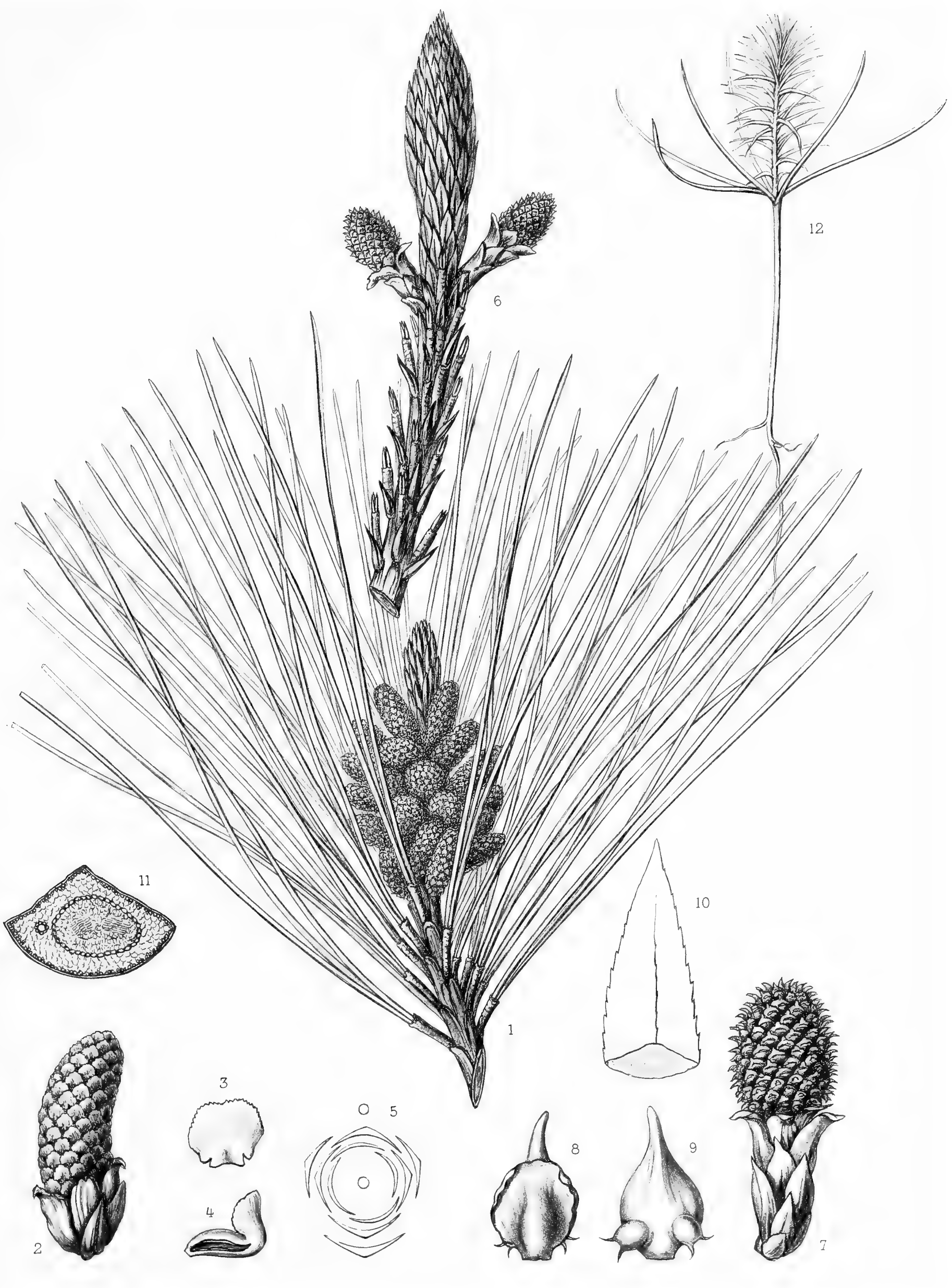
EXPLANATION OF THE PLATES.

PLATE DLXXIII. PINUS RADIATA.

1. A branch with staminate flowers, natural size.
2. A staminate flower, enlarged.
3. An anther, front view, enlarged.
4. An anther, side view, enlarged.
5. Diagram of the involucre of the staminate flower.
6. An end of a branch with pistillate flowers, natural size.
7. A pistillate flower, enlarged.
8. A scale of a pistillate flower, lower side, with its bract, enlarged.
9. A scale of a pistillate flower, upper side, with its ovules, enlarged.
10. Tip of a leaf, enlarged.
11. Cross section of a leaf magnified fifteen diameters.
12. A seedling plant, natural size.

PLATE DLXXIV. PINUS RADIATA.

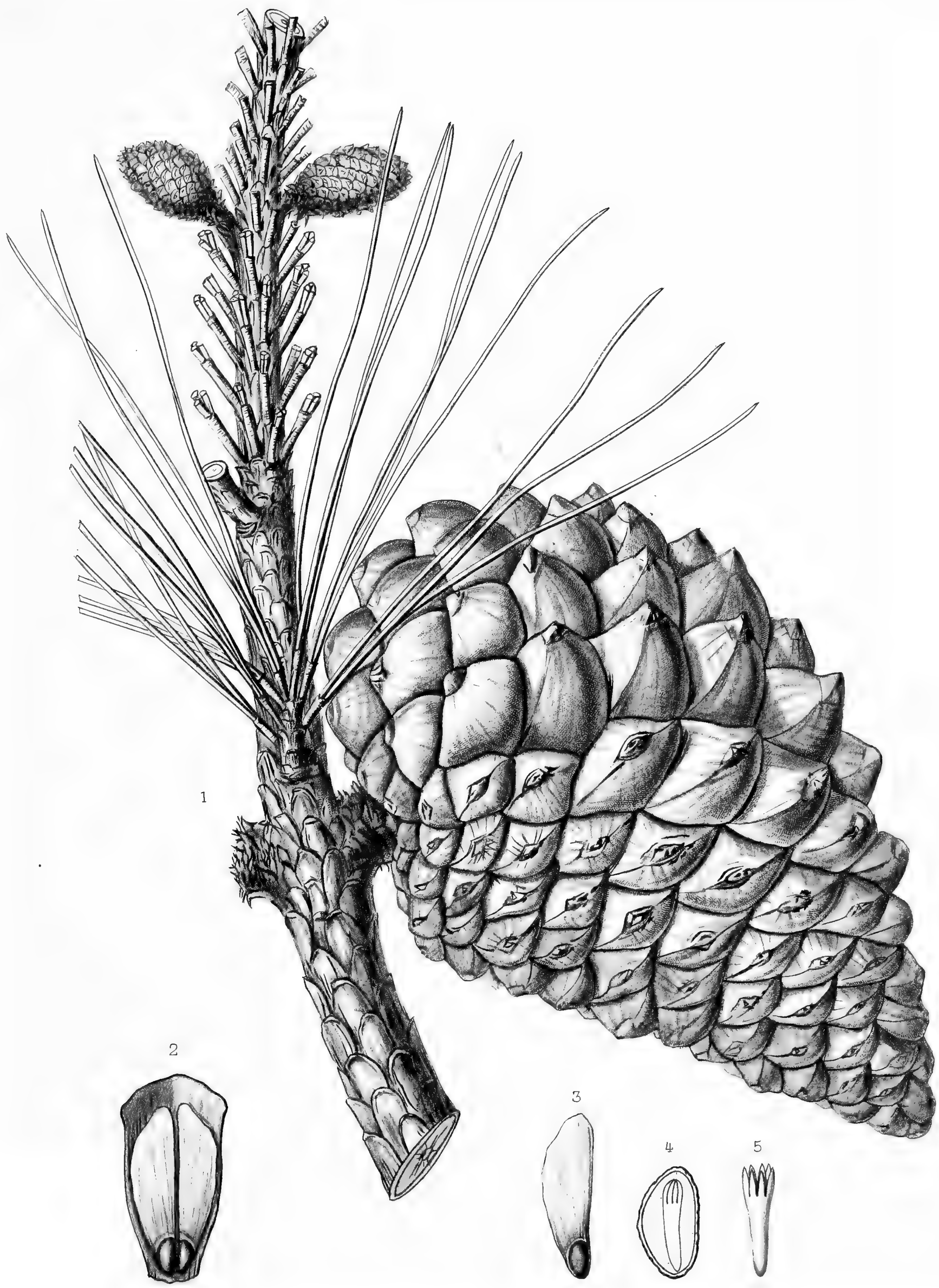
1. A fruiting branch, natural size.
2. A cone-scale, upper side, with its seeds, natural size.
3. A seed, natural size.
4. Vertical section of a seed, enlarged.
5. An embryo, enlarged.



C.E.Faxon del. *Rapine sc.*

PINUS RADIATA, D. Don.

A.Riocreux direx.t *Imp. J.Taneur, Paris.*



C.E. Faxon del. Em. Himely sc.

PINUS RADIATA, D. Don.

A. Riocreux direx.t Imp. J. Taneur, Paris.

PINUS ATTENUATA.

Knob-cone Pine.

LEAVES in 3-leaved clusters, stout, rigid, pale yellow-green, from 5 to 7 inches in length. Cones elongated-conical, oblique at the base, clustered, from 3 to 5 inches long, their scales unequally embossed, armed with stout prickles.

Pinus attenuata, Lemmon, *Mining and Scientific Press*, Jan. 16, 1892; *Garden and Forest*, v. 65; *Erythea*, i. 231; *West-American Cone-Bearers*, 42, t. 7. — Sudworth, *Rep. U. S. Dept. Agric.* 1892, 329. — Coville, *Contrib. U. S. Nat. Herb.* iv. 221 (*Bot. Death Valley Exped.*).

Pinus Californica, Hartweg, *Jour. Hort. Soc. Lond.* ii. 189 (not Hooker & Arnott) (1847).

Pinus tuberculata, Gordon, *Jour. Hort. Soc. Lond.* iv. 218, f. (not D. Don) (1849); *Fl. des Serres*, v. 517[c], f.; *Pinetum*, 211. — Lawson & Son, *List No. 10, Abietineæ*, 35. — Dietrich, *Syn.* v. 398. — A. Murray, *Rep. Oregon Exped.* 2, t. 2, f. 2. — Henkel & Hochstetter, *Syn. Nadelh.* 78 (in part). — Bolander, *Proc. Cal. Acad.* iii. 262, 317. — Lawson, *Pinetum Brit.* i. 93, t. 13, f. 1–9. — Carrière, *Traité Conif.* ed. 2, 441 (in part). — Hoopes, *Evergreens*, 123 (excl. syn. *Pinus Californica*). — (Nelson) Senilis, *Pinaceæ*, 137. — Parlatore, *De Candolle Prodr.* xvi. pt. ii. 394 (in part). — K. Koch, *Dendr.* ii. pt. ii. 309. — Engelmann, *Trans. St. Louis Acad.* iv. 183; *Brewer & Watson Bot. Cal.* ii. 128. — Veitch, *Man. Conif.* 170. — Kellogg, *Trees of California*, 62. — Sargent, *Forest Trees N. Am. 10th Census U. S.* ix. 196. — Lauche, *Deutsche Dendr.* ed. 2, 110. — Masters, *Gard. Chron.* n. ser. xxiv. 786, f. 183, 184; *Jour. R. Hort. Soc.* xiv. 241. — Lemmon, *Rep. California State Board Forestry*, ii. 76, 116, t. (*Pines of the Pacific Slope*). — Steele, *Proc. Am. Pharm. Assoc.* 1889, 243 (*The Pines of California*). — Mayr, *Wald. Nordam.* 274, t. 6, 7, f. — Beissner, *Handb. Nadelh.* 270. — Hansen, *Jour. R. Hort. Soc.* xiv. 399 (*Pinetum Danicum*). — Koehne, *Deutsche Dendr.* 34.

Pinus tuberculata, var. **acuta**, Mayr, *Wald. Nordam.* 275, t. 6, f. (1890).

A tree, usually about twenty feet high, with a trunk a foot in diameter, and often fruitful when only four or five feet tall, but occasionally from eighty to one hundred feet in height, with a trunk two and a half feet in thickness and frequently divided above the middle into two ascending main stems. The branches are comparatively slender, and while the tree is young sweep out from the stem in regular remote whorls, at first horizontally and then in graceful upward curves, forming a compact or open broad-based pyramid which in old age becomes a narrow round-topped straggling head of sparse thin foliage. The bark of young stems and branches is thin, smooth, and pale brown, and on the lower portions of old trunks it is from a quarter to a half of an inch in thickness, dark brown often tinged with purple, slightly and irregularly divided by shallow connected fissures and broken into large loose scales, and on the upper part of the tree is smooth, close, and firm. The winter branch-buds are oblong-ovate, acute, from one half to two thirds of an inch long, and about a quarter of an inch thick, with ovate lanceolate dark chestnut-brown scales slightly fringed on the margins, those of the inner ranks soon becoming reflexed and falling away, while their much thickened bases roughen the branches for years. The branchlets are slender and glabrous, and when they first appear are dark orange-brown, growing darker during their second season. The leaves are borne in clusters of three, with thin close sheaths at first bright chestnut-brown and lustrous below, white and scarious above, and about five eighths of an inch long, and in their second season dark chestnut-brown, thick and firm below, loose and often reflexed on the margins, and about an eighth of an inch in length; the leaves are slender, sharp-pointed with callous tips, coarsely and remotely serrate, firm and rigid, pale yellow, or bluish green, stomatiferous on their three faces, from three to seven inches but usually four or five inches long and about a sixteenth of an inch wide; they contain two fibro-vascular bundles and from two to five small resin passages surrounded by strengthening cells, which also occur under the epidermis,

generally in a single layer.[1] The staminate flowers are produced in elongated spikes, and are cylindrical and about half an inch long, with orange-brown anthers terminating in irregularly toothed broad crests, and are surrounded by six involucral bracts. The pistillate flowers are borne in fascicles of from two to four flowers, several fascicles often appearing on the shoot of the year, and are raised on short peduncles covered by broadly ovate dark chestnut-brown bracts scarious and fimbriate on the margins; they are oblong and about one half of an inch in length, with ovate scales terminating in long slender recurved points. At the end of the first season the young cones are erect, slightly spreading or nearly horizontal, broadly ovate, and about an inch long, with ovate incurved scales narrowed into slender rigid tips; and a year later, when fully grown, they are elongated-conical, pointed, very oblique at the base by a greater development of the scales on the upper side than on the lower side, short-stalked, strongly reflexed and incurved, from three to six inches long, from an inch and three quarters to two inches and a half thick, and light chestnut-brown, with thin flat scales rounded at the apex, those on the outside being enlarged into prominent transversely flattened knobs armed with thick flattened incurved spines, and turn upward above the middle of the cone, and are nearly straight below, while on the inner side of the cone the exposed portions of the scales are only slightly thickened and transversely keeled, and terminate in small dark umbos armed with minute recurved prickles. The cones remain on the stems and branches for thirty or forty years, often becoming completely imbedded in the bark of old trees, and usually not opening until the death of the tree, when they all open at once and scatter their seeds, although occasionally some of the oldest cones open during the life of the tree.[2] The seeds are nearly oval, compressed, rather acute at the apex, and a quarter of an inch long, with a thin black coat produced into a narrow margin, and an embryo with from five to eight cotyledons; their wings are broadest at the middle, gradually narrowed to the ends, an inch and a quarter long and a third of an inch wide, light brown, lustrous, and marked with longitudinal narrow dark stripes.

Pinus attenuata grows on dry generally sun-baked mountain slopes and is distributed from the valley of the Mackenzie River in Oregon over the mountains of southwestern Oregon, where at elevations between one and two thousand feet above the sea-level it is most abundant and grows to its largest size, often forming open nearly pure forests over large areas; it ranges southward along the western slopes of the Cascade Mountains and over the cross ranges of northern California and the western slopes of the Sierra Nevada, growing usually at elevations between fifteen hundred and three thousand feet on dry southern chaparral-covered slopes and ascending on Mt. Shasta to five thousand feet; over the California coast ranges it is scattered from the Santa Cruz to the southern slopes of the San Bernardino Mountains,[3] where it forms a nearly continuous belt several miles long between two thousand five hundred and four thousand feet above the sea, mingling toward the upper limits of its growth with *Pinus Coulteri* and *Pseudotsuga macrocarpa*, and below forming open groves of small stunted trees of loose pyramidal habit, with wide-spreading lower branches.[4]

The wood of *Pinus attenuata* is light, soft, not strong, brittle, and coarse-grained; it is light brown, with thick white sapwood sometimes slightly tinged with red, and contains very broad rather

[1] Coulter & Rose, *Bot. Gazette*, xi. 308.

[2] The closed cones of this tree, preserving the vitality of the seeds for years, seem an admirable adaptation to the peculiarly severe conditions of its surroundings, enabling it to survive the fires which constantly sweep over the dry slopes where alone it grows. When the trees are killed by fire, as is almost invariably the case every few years, all the seeds produced during their lives are scattered at the same time over the ground, and, growing rapidly, soon produce an abundant crop of seedlings; in the same groves the trees are almost invariably of the same age and size, there being no seedlings or younger plants among them to perish with the older trees and thus to diminish the chances of reproduction and perpetuity. (Muir, *The Mountains of California*, 148, as *Pinus tuberculata*.)

[3] S. B. Parish, *Zoë*, iv. 351.

[4] Considering the dryness and exposure of the slopes it inhabits, *Pinus attenuata* grows with remarkable rapidity. The log specimen in the Jesup Collection of North American Woods, in the American Museum of Natural History, New York, is twelve and a half inches in diameter inside the bark and only fifty-four years old. The sapwood on this specimen is one and seven eighths inches thick, with seventeen layers of annual growth. Young trees growing on the most arid slopes often make terminal shoots from two to three feet long.

inconspicuous bands of small summer cells, numerous large prominent resin passages, and many thin medullary rays. The specific gravity of the absolutely dry wood is 0.3499, a cubic foot weighing 21.81 pounds.

Pinus attenuata was discovered in 1847 by Karl Theodor Hartweg,[1] about twenty miles north of Monterey on the Santa Cruz Mountains, and was introduced by him into European plantations in which it is still occasionally cultivated, although as an ornamental plant it has little to recommend it.

[1] See ii. 34.

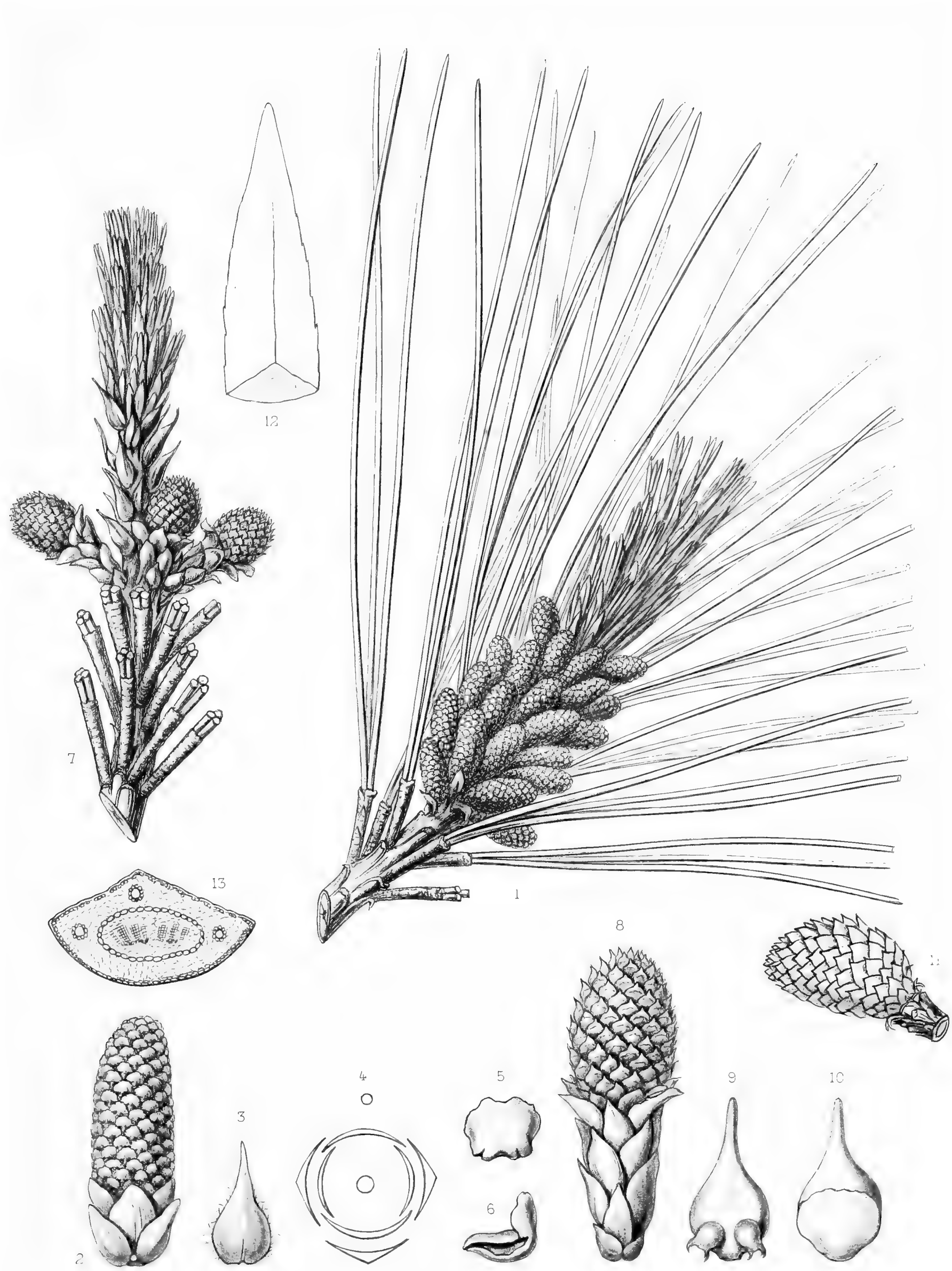
EXPLANATION OF THE PLATES.

Plate DLXXV. Pinus attenuata.

1. A branch with staminate flowers, natural size.
2. A staminate flower, enlarged.
3. A bract of a staminate flower, enlarged.
4. Diagram of the involucre of the staminate flower.
5. An anther, front view, enlarged.
6. An anther, side view, enlarged.
7. A branch with pistillate flowers, natural size.
8. A pistillate flower, enlarged.
9. A scale of a pistillate flower, upper side, with its ovules, enlarged.
10. A scale of a pistillate flower, lower side, with its bract, enlarged.
11. A cone one year old, natural size.
12. Tip of a leaf, enlarged.
13. Cross section of a leaf, magnified fifteen diameters.

Plate DLXXVI. Pinus attenuata.

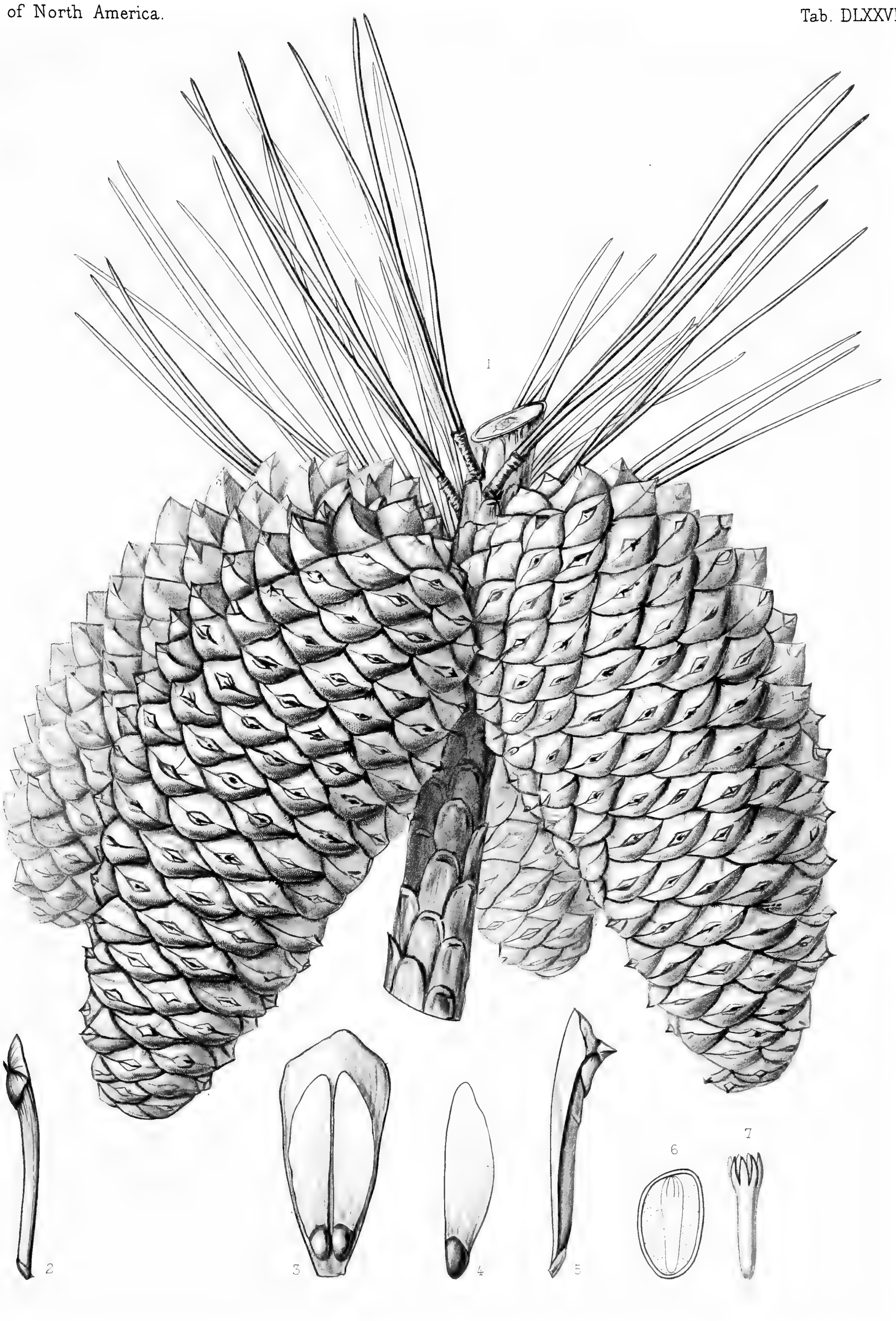
1. A fruiting branch, natural size.
2. A scale from the inner side of a cone, side view, natural size.
3. A cone-scale, upper side, with its seeds, natural size.
4. A seed, natural size.
5. A scale from the outer side of a cone, side view, natural size.
6. Vertical section of a seed, enlarged.
7. An embryo, enlarged.



C.E. Faxon del. Rapine sc.

PINUS ATTENUATA, Lemmon.

A Riocreux direx.t Imp. J. Taneur, Paris.



C.E.Faxon del. Em.Himely sc.

PINUS ATTENUATA, Lemmon.

A.Riocreux direx.t Imp. J.Taneur, Paris.

PINUS TÆDA.

Loblolly Pine. Old Field Pine.

LEAVES in 3-leaved clusters, slender, rigid, pale green, from 6 to 9 inches in length. Cones usually ovate-oblong, from 3 to 5 inches long, their scales armed with stout recurved prickles.

Pinus Tæda, Linnæus, *Spec.* 1000 (excl. hab. Canada), (1753). — Muenchhausen, *Hausv.* v. 219. — Du Roi, *Harbk. Baumz.* ii. 48. — Wangenheim, *Beschrieb. Nordam. Holz.* 210; *Nordam. Holz.* 41. — Evelyn, *Silva*, ed. Hunter, i. 277. — Schoepf, *Mat. Med. Amer.* 142. — Burgsdorf, *Anleit.* pt. ii. 162. — Castiglioni, *Viag. negli Stati Uniti*, ii. 312. — Moench, *Meth.* 365. — Willdenow, *Berl. Baumz.* 210; *Spec.* iv. pt. i. 498. — Michaux, *Fl. Bor.-Am.* ii. 205. — Lambert, *Pinus*, i. 23, t. 16, 17. — Persoon, *Syn.* ii. 578. — Desfontaines, *Hist. Arb.* ii. 612. — Du Mont de Courset, *Bot. Cult.* ed. 2, vi. 460. — Michaux, f. *Hist. Arb. Am.* i. 98, t. 9. — *Nouveau Duhamel*, v. 245, t. 75, f. 2. — Pursh, *Fl. Am. Sept.* ii. 644. — Nuttall, *Gen.* ii. 223. — Hayne, *Dendr. Fl.* 174. — Elliott, *Sk.* ii. 636. — Sprengel, *Syst.* iii. 887. — Lawson & Son, *Agric. Man.* 351; *List No. 10, Abietineæ*, 34. — Forbes, *Pinetum Woburn*, 43, t. 14. — Antoine, *Conif.* 25, t. 7, f. 1. — Link, *Linnæa*, xv. 503. — Spach, *Hist. Vég.* xi. 391. — Griffith, *Med. Bot.* 604. — Gihoul, *Arb. Rés.* 32. — Endlicher, *Syn. Conif.* 164. — Knight, *Syn. Conif.* 30. — Lindley & Gordon, *Jour. Hort. Soc. Lond.* v. 217. — Dietrich, *Syn.* v. 399. — Carrière, *Traité Conif.* 344. — Gordon, *Pinetum*, 210. — Courtin, *Fam. Conif.* 81. — Chapman, *Fl.* 433. — Curtis, *Rep. Geolog. Surv. N. Car.* 1860, iii. 22. — Henkel & Hochstetter, *Syn. Nadelh.* 66. — (Nelson) Senilis, *Pinaceæ*, 136. — Hoopes, *Evergreens*, 122. — Sénéclauze, *Conif.* 130. — Parlatore, *De Candolle Prodr.* xvi. pt. ii. 393. — K. Koch, *Dendr.* ii. pt. ii. 304. — Nördlinger, *Fortsbot.* 399. — Bentley & Trimen, *Med. Pl.* iv. 259, t. 259. — Engelmann, *Trans. St. Louis Acad.* iv. 183. — Veitch, *Man. Conif.* 172. — Lawson, *Pinetum Brit.* i. 89, t. 12. — Sargent, *Forest Trees N. Am.* 10*th Census U. S.* ix. 197. — Lauche, *Deutsche Dendr.* ed. 2, 109. — Schübeler, *Virid. Norveg.* i. 393. — Watson & Coulter, *Gray's Man.* ed. 6, 490. — Mayr, *Wald. Nordam.* 116, t. 7, f. — Beissner, *Handb. Nadelh.* 265. — Masters, *Jour. R. Hort. Soc.* xiv. 241. — Hansen, *Jour. R. Hort. Soc.* xiv. 397 (*Pinetum Danicum*). — Coulter, *Contrib. U. S. Nat. Herb.* ii. 554 (*Man. Pl. W. Texas*). — Koehne, *Deutsche Dendr.* 35. — Britton & Brown, *Ill. Fl.* i. 53, f. 118. — Mohr, *Bull.* No. 13, *Div. Forestry U. S. Dept. Agric.* 105, t. 17–20 (*The Timber Pines of the Southern U. S.*).

Pinus Tæda, α **tenuifolia**, Aiton, *Hort. Kew.* iii. 368 (1789).

A tree, with a stout tap-root, and thick lateral roots descending deeply or spreading near the surface according to the nature of the soil, usually from eighty to one hundred feet in height, with a tall straight trunk about two feet in diameter, and in wet ground often tapering gradually from the slightly thickened base, or occasionally one hundred and seventy feet high, with a trunk five feet in diameter free of limbs for seventy or eighty feet above the ground, and with short stout much divided branches, the lower spreading horizontally, the upper ascending and forming a compact round-topped head. The bark of the trunk is from three quarters of an inch to an inch and a half in thickness, bright red-brown, and irregularly divided by shallow fissures into broad flat ridges covered with large thin closely appressed scales. The winter branch-buds are widened from the base to above the middle, acute or acuminate at the apex, covered with ovate bright chestnut-brown scales contracted into long slender darker colored tips and separated on the margins into short filaments, the terminal bud, which is often twice as large as the lateral buds, being from three quarters of an inch to an inch in length and an eighth of an inch thick. The branchlets are slender and glabrous, and during their first season are brown tinged with yellow, covered with a glaucous bloom and clothed with the strongly reflexed ovate acute light chestnut-brown inner scales of the branch-buds, which usually fall during the autumn and winter, leaving their thickened bases to roughen for many years the branches, which grow gradually darker in their second year. The leaves are borne in clusters of three, with

close thin sheaths at first pale chestnut-brown below, scarious above, and about an inch in length, and in their second year about half an inch long, dark below, and loose and lacerate on the margins, and are persistent with the leaves, which fall during their third year; the leaves are slender, stiff, slightly twisted, sharp-pointed with callous tips, closely serrulate, pale green and slightly glaucous, from six to nine inches long, about one sixteenth of an inch broad, and stomatiferous with from ten to twelve rows of large stomata on each face; they contain two fibro-vascular bundles, from three to five peripheral resin ducts placed irregularly, mostly near the angles of the leaf,[1] and surrounded by small strengthening cells, which also occur under the epidermis, usually in several interrupted layers and in clusters at the angles. The staminate flowers are crowded in short spikes and are cylindrical, incurved, from three quarters of an inch to an inch long and about three eighths of an inch thick, with yellow anthers terminating in nearly orbicular denticulate crests, and are surrounded by involucres of from eight to ten ovate lanceolate lustrous dark chestnut-brown fimbriate involucral bracts, those of the lower pair being much shorter than the others and strongly keeled. The pistillate flowers are lateral below the apex of the growing shoot, which is often five or six inches long before they appear, and are oblong, from one third to one half of an inch in length, solitary, in pairs or in clusters of three, with ovate lanceolate yellow scales gradually narrowed into long slender straight or incurved tips and minute orbicular bracts, and are raised on short peduncles, covered by broadly ovate dark chestnut-brown acuminate bracts pale and scarious on the margins. The flowers open from the middle of March on the coast of the Gulf of Mexico to the first of May in the middle Atlantic states. The young cones, after the pollination of their ovules, increase rapidly in size for a few days and then slowly during the remainder of the season;[2] in their first winter they are erect or spreading, ovate-oblong, light reddish brown, about an inch in length and a quarter of an inch in breadth, with broadly ovate thickened scales rather abruptly narrowed into acicular incurved tips, and when fully grown the following October they are lateral, nearly sessile, ovate-oblong or broadly conical, usually about three but sometimes four or five inches in length, from an inch and a half to two inches in breadth, and light reddish brown, with thin slightly concave scales rounded at the apex and dark red or purple below, their exposed parts being thickened into low knobs transversely keeled and armed with short stout straight or reflexed prickles; they open slowly, discharging their seeds during the autumn and winter, and usually remain on the branches until the end of another year. The seeds are rhomboidal, full and rounded, with a thin dark brown tuberculate coat blotched with black and produced into broad thin lateral margins, and an embryo with six or seven cotyledons, and are surrounded to the base by the narrow border of their wings, which are thin and fragile, pale brown and lustrous, broadest above the middle, an inch long and about a quarter of an inch wide.

Pinus Tæda finds its most northerly home near Cape May in New Jersey,[3] and is common in the lower part of Newcastle County, Delaware, extending thence to the District of Columbia and southward through the maritime part of Virginia, and through eastern and middle North Carolina to Cape Malabar and the shores of Tampa Bay, Florida, and westward through South Carolina and Georgia and the eastern Gulf states to the bottom-lands of the Mississippi River, spreading north a few miles beyond the boundary of Alabama and Mississippi into southern Tennessee; west of the Mississippi River it ranges from southeastern Arkansas, where the northern limit of its distribution is near Little Rock on the Arkansas River, and the southwestern part of the Indian Territory, through western Louisiana to the shores of the Gulf of Mexico and through eastern Texas to the valley of the Colorado River, finding its most southwesterly station in an isolated forest[4] in Bastrop County.

[1] Coulter & Rose, *Bot. Gazette*, xi. 307.

[2] Mohr, *Bull.* No. 13, *Div. Forestry U. S. Dept. Agric.* 115 (*The Timber Pines of the Southern U. S.*).

[3] A single tree of *Pinus Tæda* was found by Gifford Pinchot and H. C. Graves in the spring of 1897, on the Price farm at Town Bank, on the west side of Cape May, about three miles from the beach. (See *Garden and Forest*, x. 192.)

[4] Fifty years ago low hills in Bastrop County, central Texas, were covered with forests of *Pinus Tæda*, which also spread into the adjacent counties. Extensive lumbering operations were car-

On the Delaware peninsula the Loblolly Pine generally inhabits low lands adjacent to tide-water, rarely forming continuous forests and growing in small colonies associated with *Pinus echinata*, and with Oaks, Hickories, and other deciduous-leaved trees; in Virginia, restricted to the tertiary coast strata, it does not occur west of Richmond, but in the maritime districts it is often the prevailing tree,[1] springing up on lands exhausted by agriculture, where it grows very rapidly and now furnishes the principal lumber supply of the region. It is exceedingly common over all the coast plain and maritime region of North Carolina, where it is frequently mixed with the Long-leaved Pine, especially south of Cape Fear; and in the swamps along the streams flowing into Albemarle and Pamlico Sounds and on the low ridges adjacent to them it attained its greatest size and perfection before its noblest specimens fell a prey to the axe of the lumberman. In the coast region of South Carolina and Georgia, and in the eastern Gulf states, the Loblolly Pine is mostly confined to the sandy borders of Pine barrens, where it is scattered through forests of Magnolias, Bays, and Gum-trees, appearing, however, as it does in many other districts, wherever its seeds are left undisturbed; and in the interior it is scattered over the high rolling Pine uplands to the foot of the eastern and southern slopes of the Appalachian Mountains, attaining sometimes an elevation of fifteen hundred feet above the level of the sea. It is less common in the Florida peninsula, where *Pinus clausa* and *Pinus heterophylla* more often cover worn-out and abandoned fields. In southeastern Arkansas and the Indian Territory it is one of the most important timber-trees, growing in great nearly pure forests on rolling uplands and low tertiary plains; and in western Louisiana and eastern Texas it forms considerable forests north of the region occupied by the Long-leaved Pine, and is scattered through the low woods which border the marshes of the coast.[2]

The wood of *Pinus Tæda*, which usually grows very rapidly,[3] varies much in quality in the different regions which it occupies and under differing conditions of growth. That of the great trees which once grew on Pamlico Sound and were valued in naval construction, and especially for the masts of large vessels, is said to have been very close-grained and durable, with thin sapwood.[4] A large part of the trees of original growth and the oldest and best matured second-growth trees now produce coarse-grained wood, nearly one half the diameter of the trunk being sapwood, while the wood of trees

ried on here, all the towns of the central and western parts of the state, before the building of the Texas railroads, being constructed from timber cut in these pineries, which, however, are now exhausted as sources of commercial prosperity.

[1] L. F. Ward, *Bot. Gazette*, xi. 33.

[2] Much of this information relating to the distribution of *Pinus Tæda* is derived from Dr. Charles Mohr's excellent monograph of this species quoted above.

[3] From the study of forty-seven trees made under the direction of the Secretary of Agriculture of the United States, it appears that during its first ten years this tree reaches a height of from eighteen to twenty feet, and that it attains its maximum rate of upward growth of rather more than twenty-four inches between its fifteenth and twentieth years, while during its third decade its annual growth is reduced to fifteen or sixteen inches. Trees thirty and fifty years old were found to have an average height of fifty feet and of seventy feet; those ninety years of age were about ninety-five feet high, later growing slowly with shoots only three or four inches long. One tree had attained a height of seventy-seven feet in thirty-six years, and another a height of seventy-six feet in forty-four years; and two trees one hundred years old were each one hundred and eighteen feet tall. The diameter accretion was found to decrease with age, while the area accretion remained nearly the same. The average trunk diameter at forty years of age was about ten inches, and at eighty years seventeen inches. (Mlodziansky, *Garden and Forest*, ix. 93.)

[4] These trees of eastern North Carolina, which vary remarkably from all others of the species in the character of their wood and especially in the thinness of the sapwood, were called Rosemary Pines, and also Great Swamp Pines, Naval Timber Pines, and Slash Pines. According to Edmund Ruffin, who in 1858 published the best account of them in volume iv., page 139, of *Russell's Magazine*, individuals from one hundred and fifty to one hundred and seventy feet in height, with trunk diameters of five feet, were not uncommon. He describes a spar cut from a tree of this variety in Bertie, North Carolina, which was eighty feet in length and thirty-six inches square at the butt; and sixteen sticks sent to New York in 1856 for shipment to Amsterdam for naval construction, under a contract with the Dutch government, which varied from forty-seven to eighty-eight feet in length, squared from nineteen to thirty inches and were nearly all of heartwood. Mr. Ruffin also describes two trees in Washington County, North Carolina, one of which was one hundred and forty-eight feet high, with a trunk diameter of thirty-five and one quarter inches, and two hundred and eighty-three years old, with two hundred and seven years of heartwood; while the other was one hundred and seventy feet high, sixty inches in diameter, and two hundred and eighty years old, with one hundred and seventy years of heartwood. A mast of the United States man-of-war Roanoke, cut in Bertie, had three hundred and two layers of annual growth, one hundred and eighty-six being of heartwood, and was forty-one inches in diameter.

which have grown rapidly on abandoned fields and now supply an important part of the timber[1] cut on the south Atlantic coast, whence it is shipped in large quantities to the north, is very coarse-grained and still more largely composed of sapwood. In the forests west of the Mississippi River it is of better quality, a considerable part of the Yellow Pine lumber shipped from southern Arkansas and western Louisiana to northern markets being of this species. The wood now attainable is generally rather weak, brittle, coarse-grained, and not durable; it is light brown, with orange-colored or often nearly white sapwood, and contains broad conspicuous resinous bands of small summer cells, few inconspicuous resin passages, and numerous obscure medullary rays. The average specific gravity of the absolutely dry wood from four trees cut east of the Mississippi River is 0.5441, a cubic foot weighing 33.91 pounds.

Pinus Tæda contains large quantities of resin, but it does not flow rapidly when the trees are boxed and soon hardens on exposure to the air, and this species is probably not much worked commercially for the production of turpentine.[2]

The first description of *Pinus Tæda*[3] was published by Plukenet in 1696;[4] it was introduced into Europe before 1713 by Bishop Compton,[5] and has grown to a large size in European collections,[6] where, although less commonly cultivated than it was several years ago, it may still be occasionally seen.[7]

[1] Ashe, *Bull.* No. 5, *North Carolina Geolog. Surv.* 41 (*The Forests, Forest Lands, and Forest Products of North Carolina*).

[2] Mohr, *Bull.* No. 13, *Div. Forestry U. S. Dept. Agric.* 112 (*The Timber Pines of the Southern U. S.*).

[3] *Pinus Virginiana tenuifolia tripilis s. ternis plerumque ex uno folliculo setis, strobilis majoribus, The Frankincense Tree, Alm. Bot.* 297. — Ray, *Hist.* pl. iii., *Dendr.* 8. *Pinus conis agminatim nascentibus, foliis longis ternis ex eadem theca*, Clayton, *Fl. Virgin.* 119.

[4] Tæda, the classical name of a resinous Pine-tree, was bestowed by Linnæus on this species.

[5] See i. 6.

[6] Aiton, *Hort. Kew.* iii. 368. — Loudon, *Arb. Brit.* iv. 2237, f. 2118–2222, t.

[7] See Maurice L. de Vilmorin, *Garden and Forest*, x. 112.

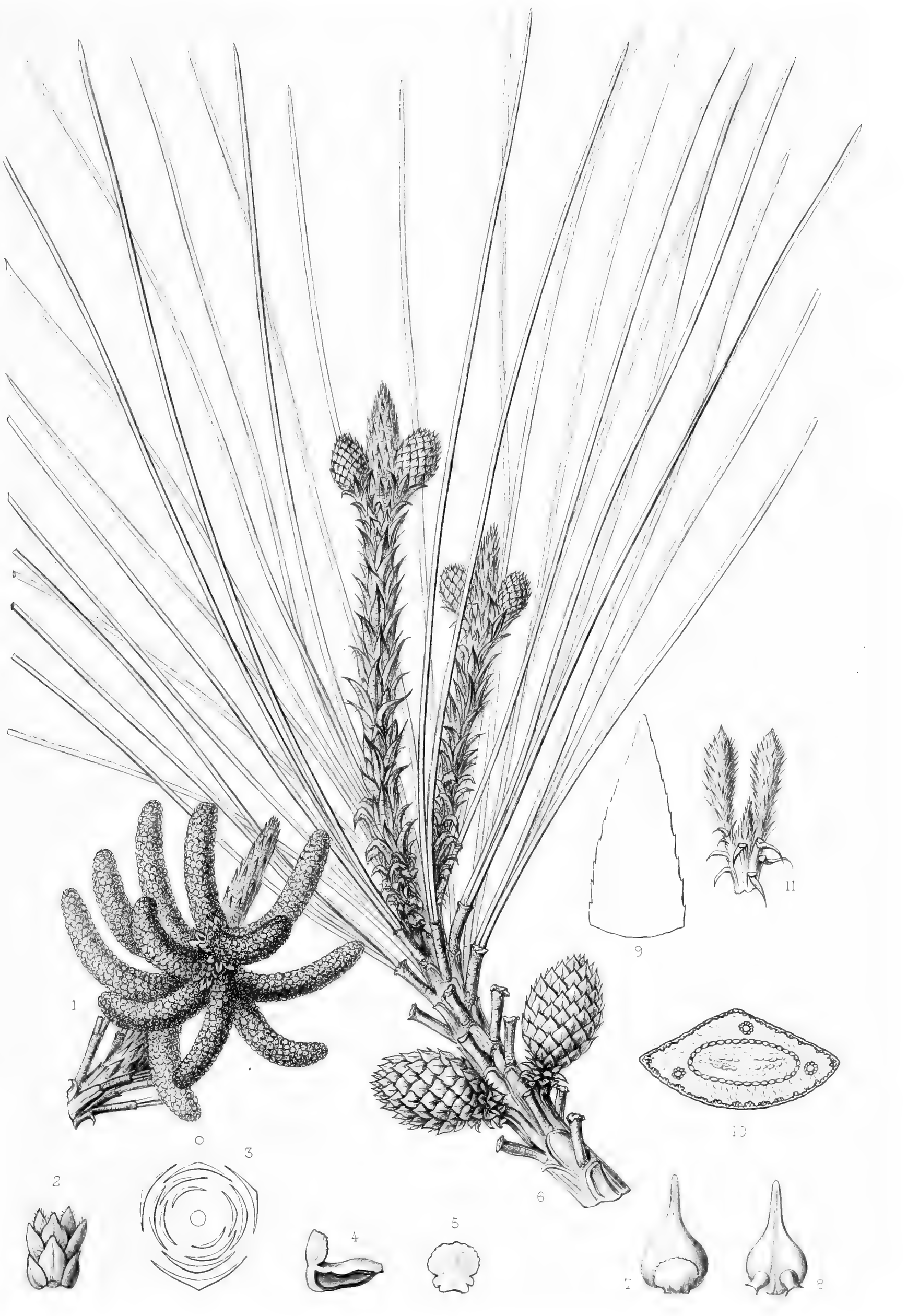
EXPLANATION OF THE PLATES.

Plate DLXXVII. Pinus Tæda.

1. A branch with staminate flowers, natural size.
2. An involucre of the staminate flower, enlarged.
3. Diagram of the involucre of the staminate flower.
4. An anther, side view, enlarged.
5. An anther, front view, enlarged.
6. A branch with pistillate flowers and yearling cones, natural size.
7. A scale of a pistillate flower, lower side, with its bract, enlarged.
8. A scale of a pistillate flower, upper side, with its ovules, enlarged.
9. Tip of a leaf, enlarged.
10. Cross section of a leaf magnified fifteen diameters.
11. Winter branch-buds, natural size.

Plate DLXXVIII. Pinus Tæda.

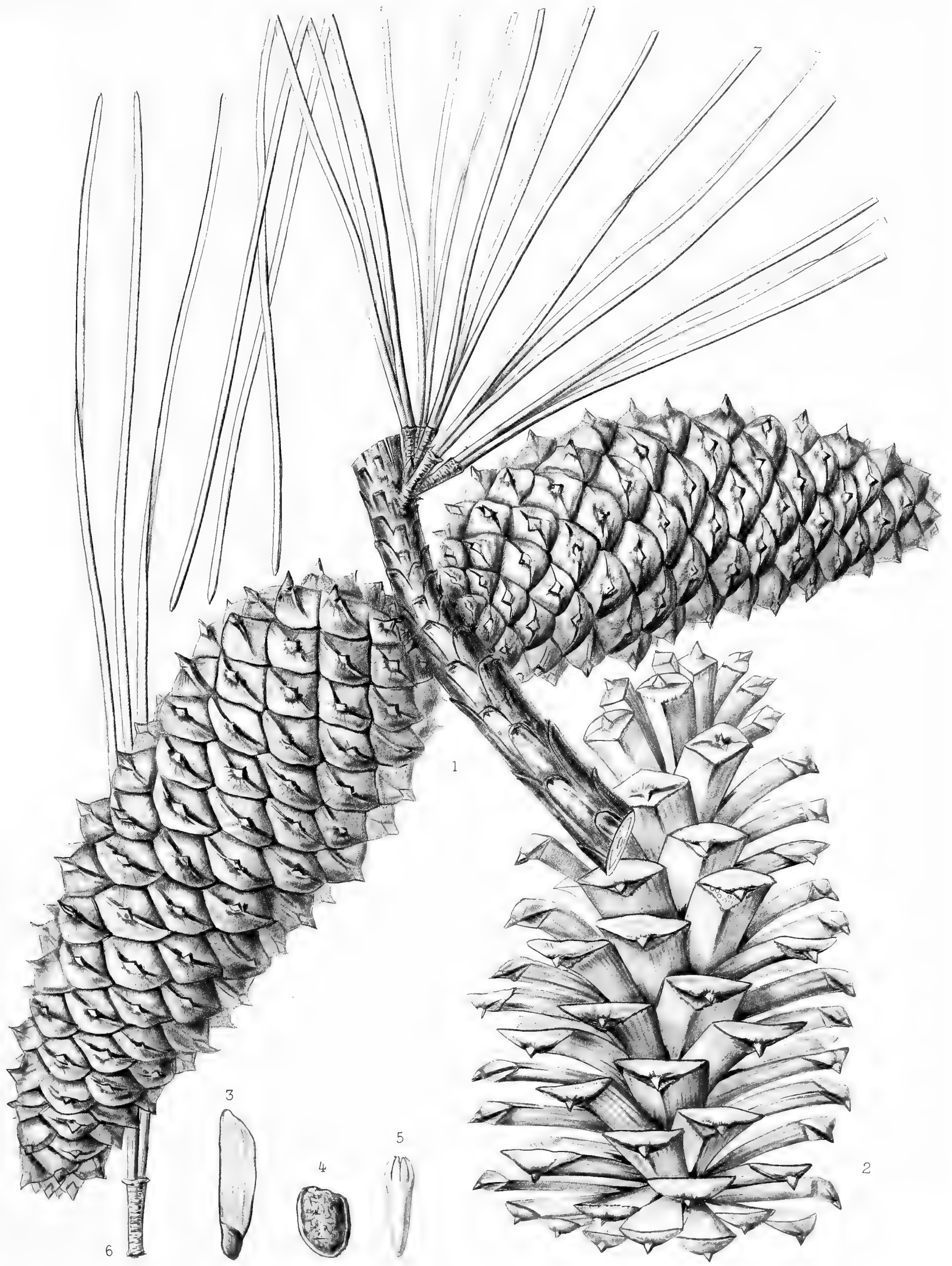
1. A fruiting branch, natural size.
2. An expanded cone, natural size.
3. A seed, natural size.
4. A seed, enlarged.
5. An embryo, enlarged.
6. A cluster of leaves, natural size.



C.E Faxon del. Rapine sc.

PINUS TÆDA, L.

A. Riocreux direx.t Imp. J. Taneur, Paris.



C.E.Faxon del. *Himely sc.*

PINUS TÆDA, L.

A.Riocreux direx.t *Imp. J Taneur, Paris.*

PINUS RIGIDA.

Pitch Pine.

LEAVES in 3-leaved clusters, stout, rigid, dark yellow-green, from 3 to 5 inches in length. Cones ovoid-conical or ovate, often clustered, their scales armed with short stout recurved prickles.

Pinus rigida, Miller, *Dict.* ed. 8, No. 10 (1768). — Muenchhausen, *Hausv.* v. 219. — Du Roi, *Harbk. Baumz.* ii. 46. — Marshall, *Arbust. Am.* 101. — Burgsdorf, *Anleit.* pt. ii. 162. — Wangenheim, *Nordam. Holz.* 41. — Borkhausen, *Handb. Forstbot.* i. 433. — Lambert, *Pinus*, i. 25, t. 18, 19. — Willdenow, *Spec.* iv. pt. i. 498; *Enum.* 988; *Berl. Baumz.* ed. 2, 268. — Persoon, *Syn.* ii. 578. — Desfontaines, *Hist. Arb.* ii. 612. — Du Mont de Courset, *Bot. Cult.* ed. 2, vi. 460. — Michaux, f. *Hist. Arb. Am.* i. 89, t, 8. — *Nouveau Duhamel*, v. 244, t. 74. — Aiton, *Hort. Kew.* ed. 2, v. 317. — Bigelow, *Fl. Boston.* 233. — Pursh, *Fl. Am. Sept.* ii. 643. — Poiret, *Lamarck Dict.* Suppl. iv. 417. — Nuttall, *Gen.* ii. 223. — Hayne, *Dendr. Fl.* 174. — Elliott, *Sk.* ii. 634. — Sprengel, *Syst.* iii. 887. — Lawson & Son, *Agric. Man.* 352; *List No. 10, Abietineæ*, 33. — Forbes, *Pinetum Woburn.* 41, t. 13. — Antoine, *Conif.* 26, t. 7, f. 2. — Link, *Linnæa*, xv. 503. — Spach, *Hist. Vég.* xi. 388. — Torrey, *Fl. N. Y.* ii. 227. — Griffith, *Med. Bot.* 604. — Gihoul, *Arb. Rés.* 31. — Endlicher, *Syn. Conif.* 164. — Knight, *Syn. Conif.* 30. — Lindley & Gordon, *Jour. Hort. Soc. Lond.* v. 217. — Dietrich, *Syn.* v. 399. — Carrière, *Traité Conif.* 342. — Darlington, *Fl. Cestr.* ed. 3, 290. — Gordon, *Pinetum*, 207. — Courtin, *Fam. Conif.* 79. — Chapman, *Fl.* 433. — Curtis, *Rep. Geolog. Surv. N. Car.* 1860, iii. 21. — Henkel & Hochstetter, *Syn. Nadelh.* 67. — (Nelson) Senilis, *Pinaceæ*, 128. — Hoopes, *Evergreens*, 119. — Sénéclauze, *Conif.* 128. — Parlatore, *De Candolle Prodr.* xvi. pt. ii. 394. — K. Koch, *Dendr.* ii. pt. ii. 307. — Nördlinger, *Forstbot.* 399. — Engelmann, *Trans. St. Louis Acad.* iv. 183. — Veitch, *Man. Conif.* 169. — Sargent, *Forest Trees N. Am.* 10*th Census U. S.* ix. 197. — Lauche, *Deutsche Dendr.* ed. 2, 109. — Schübeler, *Virid. Norveg.* i. 393. — Willkomm, *Forst. Fl.* 190. — Watson & Coulter, *Gray's Man.* ed. 6, 490. — Mayr, *Wald. Nordam.* 188, t. 8, f. — Beissner, *Handb. Nadelh.* 266, f. 63, 64. — Masters, *Jour. R. Hort. Soc.* xiv. 239. — Hansen, *Jour. R. Hort. Soc.* xiv. 389 (*Pinetum Danicum*). — Koehne, *Deutsche Dendr.* 35. — Britton & Brown, *Ill. Fl.* i. 53, f. 119.

Pinus Tæda, *β* **rigida**, Aiton, *Hort. Kew.* iii. 368 (1789). — Castiglioni, *Viag. negli Stati Uniti*, ii. 313. — Willdenow, *Berl. Baumz.* 210.

Pinus Tæda, var. **A**, Poiret, *Lamarck Dict.* v. 340 (1804).

Pinus rigida, var. **lutea**, Kellerman, *Bot. Gazette*, xvii. 280 (not *Pinus lutea*, Walter nor Gordon) (1892).

A tree, fifty or sixty or rarely eighty feet in height, with a short trunk occasionally three feet in diameter, frequently fruitful when only a few feet high, and often producing freely from the stump or from the stem and branches after injury by fire many vigorous shoots[1] clothed with primary leaves from an inch to an inch and a quarter in length, about a sixteenth of an inch wide, serrate with remote callous teeth, and pale glaucous green. The branches of young trees are rigid and produced in regular remote whorls and, spreading horizontally, form an open narrow pyramid; in old age they become stout, contorted, and often pendulous at the extremities, and covered with thick much roughened bark, and form a round-topped thin head usually occupying about three quarters of the height of the tree, or when an individual standing alone has enjoyed light, and space for lateral development, a broad low round-topped and often exceedingly picturesque crown.[2] The bark of young stems is thin and broken into plate-like dark red-brown scales, and on old trunks it is from three quarters of an inch to nearly an inch and a half in thickness, deeply and irregularly fissured and divided into broad flat connected ridges separating on the surface into many thick dark red-brown scales often tinged with purple. The winter branch-buds are ovate or obovate-oblong, rather obliquely narrowed and acute at the apex, from one half to three quarters of an inch in length and about a quarter of an inch in thickness, with loosely imbricated ovate lanceolate dark chestnut-brown lustrous scales scarious and fringed on the margins,

[1] Pinchot, *Garden and Forest*, x. 192, f. 24.

[2] *Garden and Forest*, iv. 397, f. 65.

those of the inner ranks soon becoming reflexed on the lengthening shoots and falling from their bases, which become much thickened and dark brown or often nearly black and roughen the stout branches for years. The branchlets, which when they first appear are glabrous and bright green, during their first winter are dull orange-color, and then gradually growing darker, especially on the upper side, become dark gray-brown at the end of four or five years. The leaves are borne in clusters of three,[1] and when they first emerge from the sheaths these are half an inch long, thin and close, pale chestnut-brown below and white and scarious above, but soon losing their inner scales become from an eighth to a quarter of an inch in length, thick, close, and dark brown or often almost black, and fall with the leaves during their second year; the leaves stand out stiffly and at right angles with the branches and are firm, sharply and closely serrulate, acuminate with callous tips, dark yellow-green, stomatiferous on the three faces with many rows of deep-set stomata, and from three to five inches in length; they contain two fibro-vascular bundles, from three to seven resin ducts, several being often smaller than the others and internal, surrounded by small strengthening cells, which also occur under the epidermis in bundles or in a single layer, and are numerous and clustered in the angles of the leaf.[2] The staminate flowers are produced in short crowded spikes and are cylindrical, flexuous, and about three quarters of an inch long, with yellow anthers terminating in nearly orbicular entire crests, and are surrounded by from six to eight involucral bracts. The pistillate flowers are lateral, often clustered and raised on short stout peduncles covered with ovate oblong acute dark chestnut-brown bracts scarious on the margins, and are subglobose and about an eighth of an inch long, their ovate light green scales being more or less tinged with rose-color and contracted into long slender slightly spreading tips. The young cones grow slowly during their first season, and in the winter they are erect or spreading and about half an inch long, their much thickened scales terminating in long thin straight or reflexed spines; beginning to grow the following spring before the expansion of the branch-buds, they turn dark green with the exception of the light brown umbos, and attain their full size in the early autumn, when they are ovate-conical or ovate, nearly sessile, often clustered, from one to three and a half inches long, with thin flat scales rounded or slightly narrowed at the apex, their exposed portions being somewhat thickened and conspicuously transversely keeled, with small dark elevated umbos terminating in slender recurved rigid prickles; slowly opening and shedding their seeds throughout the autumn and winter, they turn from green to light brown on the exposed portions and upper side of the scales, and dull mahogany-red on the lower side, often remaining on the branches and on the stems of young trees for ten or twelve years. The seeds are nearly triangular, full and rounded on the sides and about a quarter of an inch long, with a thin dark brown mottled tuberculate coat and an embryo with from four to six cotyledons; their wings are broadest below the middle, gradually narrowed to the very oblique apex, three quarters of an inch long and a third of an inch wide.

Pinus rigida is distributed from the valley of the St. John's River in New Brunswick to the northern shores of Lake Ontario,[3] where it is not abundant, southward through the Atlantic states to northern Georgia, crossing the Alleghany Mountains to their western foothills in West Virginia, Kentucky, and Tennessee. An inhabitant of sandy plains and dry gravelly uplands, or less frequently of cold deep swamps, the Pitch Pine is very abundant on the New England coast south of the Bay of Massachusetts, in southern New Jersey, where it forms extensive forests,[4] on the Delaware peninsula,[5] through the middle districts of Virginia and of North and South Carolina, and in the interior wherever it finds the barren soil on which it is able to maintain itself against trees requiring more generous nourishment for the development of their full vigor, often ascending to the upper slopes of the Alleghany Mountains of New Jersey, Pennsylvania, and Virginia.

[1] On vigorous stump shoots the first foliage leaves are occasionally borne in clusters of two, four, or five.

[2] Coulter & Rose, *Bot. Gazette*, xi. 307. — Bastin & Trimble, *Am. Jour. Pharm.* 65, f. 8.

[3] Brunet, *Cat. Vég. Lig. Can.* 57. — Macoun, *Cat. Can. Pl.* 467.

[4] See *Garden and Forest*, i. 59. — Sargent, *Garden and Forest*, i. 166, f. — Gifford, *Rep. Geolog. Surv. New Jersey*, 1894, 251.

[5] Rothrock, *Forest Leaves*, ii. 83. f.

The wood of *Pinus rigida* is light, soft, not strong, brittle, coarse-grained, and very durable; it is light brown or red, with thick yellow or often nearly white sapwood, and contains broad bands of small summer cells, many conspicuous resin passages, and numerous obscure medullary rays. The specific gravity of the absolutely dry wood is 0.5151, a cubic foot weighing 32.10 pounds. It is largely used for fuel and in the manufacture of charcoal, and is occasionally sawed into lumber; in the middle states it was employed in early times for the sills and beams of buildings.

The wood contains large quantities of resin, and before the products of the richer pineries of the south reached northern markets it furnished considerable quantities of turpentine and of tar, which in New England and the middle states was of some commercial importance up to the time of the Revolution.[1]

The earliest account of *Pinus rigida* was published in 1743,[2] and it was cultivated in England a few years later.[3] The ease and cheapness with which it can be raised from seeds, and its rapid growth in the northern states on soil too sterile to produce crops of other wood, give special silvicultural value to the Pitch Pine, and large areas of barren sands on Cape Cod and on the island of Nantucket, Massachusetts, have been successfully covered with forests of this tree.[4] In recent years it has been tried in forest-planting in Germany, where, however, it gives little promise of surpassing the indigenous species in any useful quality.[5]

[1] "The Firre and Pine trees that grow in many places, shooting up exceeding high, especially the Pine: they doe afford good masts, good board, Rozin and Turpentine. Out of these Pines is gotten the candle-wood that is so much spoken of, which may serve for a shift amongst poore folkes; but I cannot commend it for singular good, because it is something sluttish, dropping a pitchie kinde of substance where it stands." (Wood, *New England's Prospect*, pt. i. chap. ii. 15.)

The Pines alluded to here are probably both *Pinus Strobus* and *Pinus rigida*, the former supplying the masts and boards, and the latter resin, turpentine, and kindling-wood.

At the first meeting of a company, held in Plymouth, Massachusetts, on the 10th of March, 1679, which had recently acquired lands on Buzzard's Bay, where *Pinus rigida* is still common, it was agreed that those who "first settell and are Livers shall be allowed to make ten Barrells of tarr a peice for a year." (See Bliss, *Colonial Times on Buzzard's Bay*, 5.)

"The Trade in *Glocester-County* consists chiefly in *Pitch*, *Tar*, and *Rosin*; the later of which is made by Robert Styles, an excellent *Artist* in that sort of Work, for he delivers it as clear as any *Gum Arabick*." (Gabriel Thomas, *An Historical and Geographical account of the Province and County of Pennsylvania and of West-New-Jersey in America* [*The History of West-New-Jersey*, 32].)

[2] *Pinus foliis longissimis ex una theca ternis*, Colden, *Act. Hort. Ups.* 1743, 230 (*Pl. Novebor.*).

Pinus Canadensis trifolia conis aculeatis, Duhamel, *Traité des Arbres*, ii. 126 (excl. syn. *Fl. Virgin.*).

Pinus Americana foliis prælongis subinde ternis, conis plurimis confertim nascentibus, Duhamel, *Traité des Arbres*, ii. 126.

[3] Loudon, *Arb. Brit.* iv. 2239, f. 2123–2126.

[4] Bowditch, *Rep. Sec. Connecticut State Board Agric.* 1877–78, 235. — *Garden and Forest*, iv. 442.

The trees in these plantations, raised from seeds sown in shallow furrows on barren land covered only with grasses and sedges and fully exposed to ocean gales, and in the aggregate covering several thousand acres, represent one of the most interesting and successful silvicultural experiments made in the United States, although the trees have suffered from the attacks of the larvæ of *Retinia frustrana*, a small lepidopterous insect which has nearly exterminated those planted many years ago on Nantucket (Scudder, *The Pine Moth of Nantucket*).

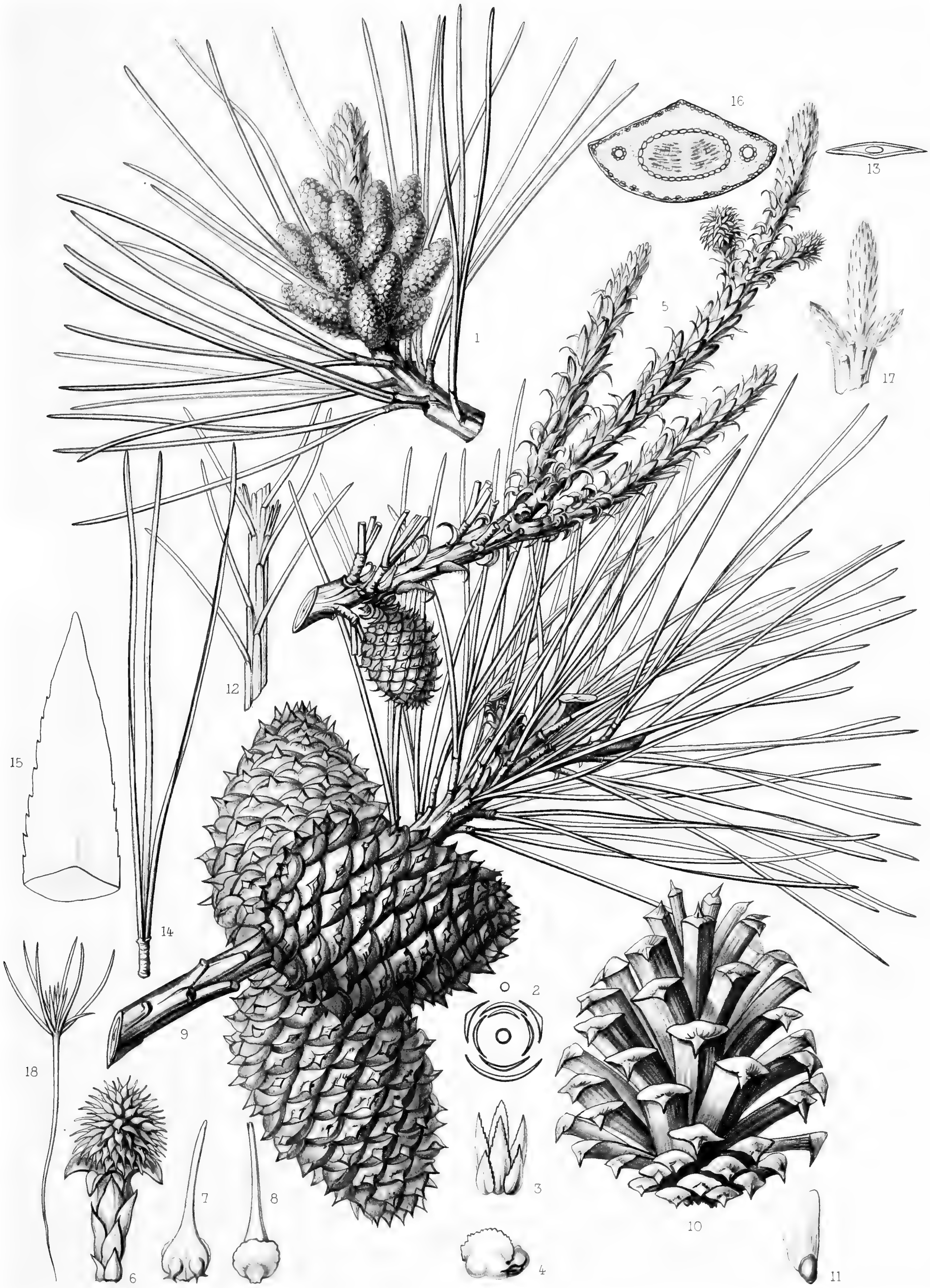
[5] R. Hartig, *Forst.-Nat. Zeit.* i. 430.

In recent years great quantities of the seeds of *Pinus rigida* have been imported into Europe for forest-planting in the belief that it was this tree which produced the pitch pine largely exported from the United States and the wood of *Pinus palustris*.

EXPLANATION OF THE PLATE.

PLATE DLXXIX. PINUS RIGIDA.

1. A branch with staminate flowers, natural size.
2. Diagram of the involucre of the staminate flower.
3. An involucre of a staminate flower, enlarged.
4. An anther, front view, enlarged.
5. A branch with pistillate flowers, natural size.
6. A pistillate flower, enlarged.
7. A scale of a pistillate flower, upper side, with its ovules, enlarged.
8. A scale of a pistillate flower, lower side, with its bract, enlarged.
9. A fruiting branch, natural size.
10. A cone, natural size.
11. A seed, natural size.
12. Portion of a stump shoot with primordial leaves, natural size.
13. Cross section of a primordial leaf, enlarged.
14. A cluster of foliage leaves, natural size.
15. Tip of a leaf, enlarged.
16. Cross section of a leaf magnified fifteen diameters.
17. Winter branch-buds, natural size.
18. A seedling plant, natural size.



C.E.Faxon del. *Migneaux sc.*

PINUS RIGIDA, Mill.

A.Riocreux direx.t *Imp. J. Taneur, Paris.*

PINUS SEROTINA.

Pond Pine. Marsh Pine.

LEAVES mostly in 3-leaved clusters, slender, dark yellow-green, from 6 to 8 inches in length. Cones subglobose or obovate-oblong, from 2 to $2\frac{1}{2}$ inches long, serotinous, their scales armed with slender incurved deciduous prickles.

Pinus serotina, Michaux, *Fl. Bor.-Am.* ii. 205 (1803). — Willdenow, *Spec.* iv. pt. i. 499. — Persoon, *Syn.* ii. 578. — Du Mont de Courset, *Bot. Cult.* ed. 2, vi. 461. — Michaux, f. *Hist. Arb. Am.* i. 86, t. 7. — *Nouveau Duhamel*, v. 246, t. 75, f. 1. — Pursh, *Fl. Am. Sept.* ii. 643. — Poiret, *Lamarck Dict.* Suppl. iv. 417. — Nuttall, *Gen.* ii. 223. — D. Don, *Lambert Pinus*, iii. t. — Elliott, *Sk.* ii. 634. — Sprengel, *Syst.* iii. 887. — Lawson & Son, *Agric. Man.* 353; *List No. 10, Abietineæ*, 34. — Forbes, *Pinetum Woburn.* 47, t. 16. — Antoine, *Conif.* 27, t. 8, f. 2. — Link, *Linnæa*, xv. 504. — Spach, *Hist. Vég.* xi. 389. — Gihoul, *Arb. Rés.* 32. — Endlicher, *Syn. Conif.* 163. — Lindley & Gordon, *Jour. Hort. Soc. Lond.* v. 217. — Dietrich, *Syn.* v. 399. — Carrière, *Traité Conif.* 341. — Gordon, *Pinetum*, 209. — Courtin, *Fam. Conif.* 80. — Chapman, *Fl.* 433. — Curtis, *Rep. Geolog. Surv. N. Car.* 1860, iii. 21. — Henkel & Hochstetter, *Syn. Nadelh.* 70. — (Nelson) Senilis, *Pinaceæ*, 129. — Sénéclauze, *Conif.* 129. — Parlatore, *De Candolle Prodr.* xvi. pt. ii. 394. — K. Koch, *Dendr.* ii. pt. ii. 305. — Sargent, *Forest Trees N. Am. 10th Census U. S.* ix. 198. — Mayr, *Wald. Nordam.* 115, t. 8, f. — Masters, *Jour. R. Hort. Soc.* xiv. 239. — Hansen, *Jour. R. Hort. Soc.* xiv. 392 (*Pinetum Danicum*).

? **Pinus Tæda**, δ **alopecuroidea**, Aiton, *Hort. Kew.* iii. 368 (1789). — Loudon, *Arb. Brit.* iv. 2237.

? **Pinus alopecuroides**, Du Mont de Courset, *Bot. Cult.* iii. 763 (1802).

Pinus rigida, var. **serotina**, Loudon, *Arb. Brit.* iv. 2242, f. 2127–2130 (1838). — Hoopes, *Evergreens*, 120. — Engelmann, *Trans. St. Louis Acad.* iv. 183. — Beissner, *Handb. Nadelh.* 269.

A tree, usually forty or fifty or occasionally seventy or eighty feet in height, with a short trunk sometimes three but generally not more than two feet in diameter, and stout often contorted branches more or less pendulous at the extremities, forming an open round-topped head, and when injured by fire often producing from adventitious buds on the stem and branches numerous vigorous shoots, which are also developed from the stumps of cut trees.[1] The bark of the trunk is from one half to three quarters of an inch in thickness, and is dark red-brown and irregularly divided by narrow shallow fissures into small plates separating on the surface into thin closely appressed scales. The winter branch-buds are broadly ovate, gradually tapering and acute at the apex, from one third to one half of an inch long, and covered by ovate acute scales pale chestnut-brown below, darker above the middle, and fimbriate on the margins, those of the inner ranks being lanceolate, long-pointed and reflexed on the lengthening shoot, from which they soon fall, leaving their thickened dark bases to roughen for many years the slender glabrous branches; these when they first appear are dark green, and during their first winter are dark dull orange-color; then gradually growing darker, they become at the end of four or five years dark brown or often nearly black. The leaves are borne in clusters of three, or occasionally of four on vigorous young shoots, with sheaths which at first are thin, white and scarious, or pale chestnut-brown below, and from three quarters of an inch to nearly an inch in length, but after losing their inner scales become thick, firm, about a quarter of an inch long, and nearly black, falling with the leaves during their third and fourth years; the leaves are flexuous, serrulate with minute close teeth, acuminate with callous tips, stomatiferous with many rows of deep-set stomata on the three faces, dark yellow-green, from six to eight inches long and about a sixteenth of an inch wide; they contain two fibro-vascular bundles, from five to seven resin ducts unequal in size, some of them being often internal, and strengthening cells in bundles or in a single layer under the epidermis and in clusters at the angles of the leaf.[2] The staminate flowers are produced in crowded spikes from two

[1] Fernow, *Garden and Forest*, x. 209.

[2] Coulter & Rose, *Bot. Gazette*, xi. 307.

to two and a half inches in length and are oblong, cylindrical, and nearly an inch long, with dark orange-colored anthers terminating in orbicular denticulate crests, and are surrounded by from six to eight involucral bracts. The pistillate flowers are lateral, clustered or in pairs on stout peduncles three eighths of an inch in length, and covered by broadly ovate acute dark chestnut-brown bracts scarious and lacerate on the margins, especially those of the inner ranks, and are ovate-oblong, with scales gradually narrowed into slender incurved tips. The young cones are horizontal during their first winter, and from one half to five eighths of an inch long, with thickened light brown scales armed with stout incurved spines; when fully grown they are subglobose or obovate-oblong, full and rounded or pointed at the apex, bright green, from two to two and a half inches long, horizontal or slightly declinate, and subsessile or short-stalked, with thin nearly flat scales rounded at the apex, their exposed portions, which are conspicuously transversely keeled and slightly thickened, terminating in small oblong dark umbos armed with slender incurved mostly deciduous prickles; they turn light yellow-brown and remain closed until the end of one or two years more, and then remain on the branches for several years longer. The seeds are nearly triangular, often ridged below, full and rounded on the sides, and about an eighth of an inch long, with a thin nearly black tuberculate coat produced into a wide marginal border, and an embryo with from four to six cotyledons; their wings are thin and fragile, dark brown, striate and lustrous, broadest at the middle, gradually narrowed at the ends, three quarters of an inch long and one quarter of an inch wide.

Pinus serotina is distributed from North Carolina southward in the neighborhood of the coast to the shores of the St. John's River in northern Florida, growing on low flats with *Pinus palustris*, or in sandy or peaty swamps, where, associated with Magnolias, Bays, and Gum-trees, it is the only Pine of large areas, or is mingled with *Pinus Tæda*.

The wood of *Pinus serotina* is very resinous, heavy, soft, brittle, and coarse-grained; it is dark orange-color, with thick pale yellow sapwood, and contains broad bands of small summer cells, often constituting nearly one half the annual growth, large conspicuous dark-colored resin passages, and numerous obscure medullary rays. The specific gravity of the absolutely dry wood is 0.7942, a cubic foot weighing 49.49 pounds. It is said to furnish now a considerable part of the lumber cut on the coast of North Carolina, where this tree is also tapped for the production of turpentine,[1] and formerly was used for the masts of small vessels.[2]

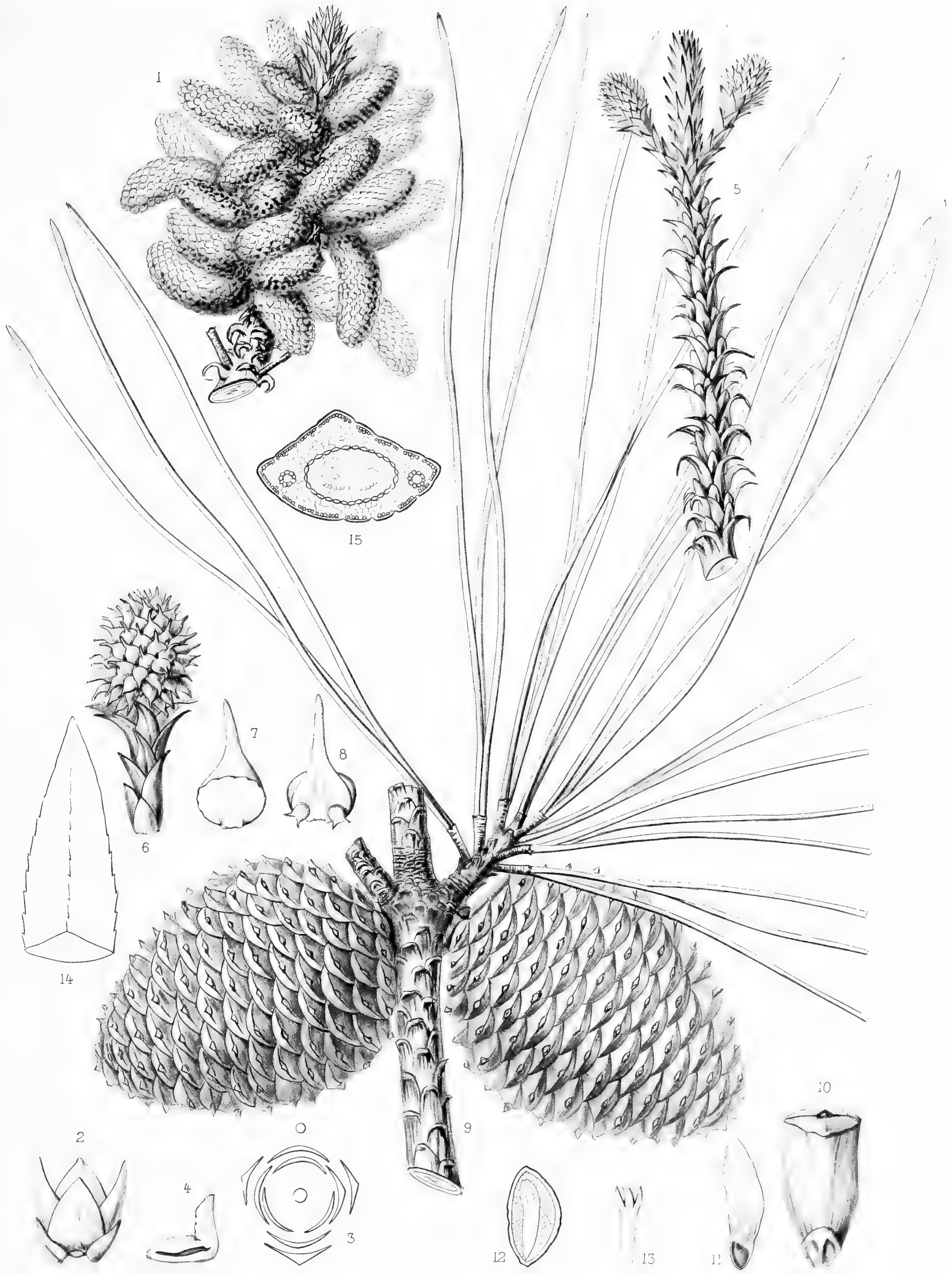
[1] Fernow, *Garden and Forest*, x. 209.

[2] Ruffin, *Russell's Magazine*, iv. 144.

EXPLANATION OF THE PLATE.

Plate DLXXX. Pinus serotina.

1. An end of a branch with staminate flowers, natural size.
2. An involucre of a staminate flower, enlarged.
3. Diagram of the involucre of the staminate flower.
4. An anther, side view, enlarged.
5. An end of a branch with pistillate flowers, natural size.
6. A pistillate flower, enlarged.
7. A scale of a pistillate flower, under side, with its bract, enlarged.
8. A scale of a pistillate flower, upper side, with its ovules, enlarged.
9. A fruiting branch, natural size.
10. A cone-scale, lower side, natural size.
11. A seed, with its wing, natural size.
12. Vertical section of a seed, enlarged.
13. An embryo, enlarged.
14. Tip of a leaf, enlarged.
15. Cross section of a leaf, magnified fifteen diameters.



C.E.Faxon del. *Hunely sc.*

PINUS SEROTINA, Michx.

A.Riocreux direx.t *Imp. J.Taneur, Paris.*

PINUS VIRGINIANA.

Jersey Pine. Scrub Pine.

LEAVES in 2-leaved clusters, stout, gray-green, from $1\frac{1}{2}$ to 3 inches in length. Cones oblong-conical, often more or less curved, from 2 to 3 inches long, their scales armed with slender straight or recurved prickles.

Pinus Virginiana, Miller, *Dict.* ed. 8, No. 9 (1768). — Du Roi, *Obs. Bot.* 43; *Harbk. Baumz.* ii. 35. — Muenchhausen, *Hausv.* v. 218. — Marshall, *Arbust. Am.* 102. — Burgsdorf, *Anleit.* pt. ii. 161. — Wangenheim, *Nordam. Holz.* 74. — Poiret, *Lamarck Dict.* v. 339. — K. Koch, *Dendr.* ii. pt. ii. 299. — Britton & Brown, *Ill. Fl.* i. 52, f. 115.

Pinus inops, Aiton, *Hort. Kew.* iii. 367 (1789). — Willdenow, *Berl. Baumz.* 208; *Spec.* iv. pt. i. 496; *Enum.* 988. — Michaux, *Fl. Bor.-Am.* ii. 204. — Lambert, *Pinus*, i. 18, t. 13. — Persoon, *Syn.* ii. 578. — Du Mont de Courset, *Bot. Cult.* ed. 2, vi. 459. — Michaux f. *Hist. Arb. Am.* i. 58, t. 4. — *Nouveau Duhamel*, v. 236, t. 69, f. 1. — Pursh, *Fl. Am. Sept.* ii. 641. — Nuttall, *Gen.* ii. 223. — Hayne, *Dendr. Fl.* 173. — Elliott, *Sk.* ii. 633. — Sprengel, *Syst.* iii. 886. — Lawson & Son, *Agric. Man.* 346; *List No. 10, Abietineæ*, 36. — Audubon, *Birds*, t. 97. — Forbes, *Pinetum Woburn.* 15, t. 4. — Hooker, *Fl. Bor.-Am.* ii. 161 (in part). — Antoine, *Conif.* 17, t. 5, f. 3. — Link, *Linnæa*, xv. 500. — Spach, *Hist. Vég.* xi. 386. — Endlicher, *Syn. Conif.* 167. — Knight, *Syn. Conif.* 26. — Lindley & Gordon, *Jour. Hort. Soc. Lond.* v. 217. — Dietrich, *Syn.* v. 399. — Carrière, *Traité Conif.* 360. — Darlington, *Fl. Cestr.* ed. 3, 290. — Gordon, *Pinetum*, 167. — Courtin, *Syn. Conif.* 83. — Chapman, *Fl.* 433. — Curtis, *Rep. Geolog. Surv. N. Car.* 1860, iii. 20. — Henkel & Hochstetter, *Syn. Nadelh.* 22. — (Nelson) Senilis, *Pinaceæ*, 113. — Hoopes, *Evergreens*, 84. — Sénéclauze, *Conif.* 136. — Parlatore, *De Candolle Prodr.* xvi. pt. ii. 380 (excl. syn. *Pinus variabilis*). — Nördlinger, *Forstbot.* 397. — Veitch, *Man. Conif.* 158. — Sargent, *Forest Trees N. Am.* 10*th Census U. S.* ix. 198. — Lauche, *Deutsche Dendr.* ed. 2, 108. — Schübeler, *Virid. Norveg.* i. 390. — Willkomm, *Forst. Fl.* 242. — Watson & Coulter, *Gray's Man.* ed. 6, 491. — Mayr, *Wald. Nordam.* 191, t. 8, f. — Beissner, *Handb. Nadelh.* 215. — Masters, *Jour. R. Hort. Soc.* xiv. 230. — Hansen, *Jour. R. Hort. Soc.* xiv. 363 (*Pinetum Danicum*). — Koehne, *Deutsche Dendr.* 36.

Pinus sylvestris, γ Novo-Cæsariensis, Castiglioni, *Viagnegli Stati Uniti*, ii. 313 (1790).

A tree, usually thirty or forty feet in height, with a short trunk rarely more than eighteen inches in diameter and long horizontal or pendulous branches in remote whorls, forming a broad open often flat-topped pyramid, or toward the western limits of its range frequently one hundred and ten feet tall, with a stem from two and a half to three feet in diameter. The bark of the trunk is from one quarter to one half of an inch in thickness, and is broken by shallow fissures into flat scale-like plates separating on the surface into thin closely appressed dark brown scales tinged with red. The winter branch-buds are ovate, acute, and from one third to one half of an inch in length, with ovate acute dark chestnut-brown scales scarious on the margins and soon reflexed on the growing shoots, from which they fall during the summer, leaving their slightly thickened bases to mark for several years the branches. These are slender, glabrous, tough and flexible, and when they first appear are pale green or green tinged with purple and covered with a glaucous bloom, becoming purplish at the end of their first season, and a year later light gray-brown. The leaves are borne in two-leaved remote clusters, with sheaths which at first are thin, close and scarious, and about a third of an inch long, becoming before the end of the first season thick, dark brown, and not more than an eighth of an inch long, with loose fringed margins; the leaves are twisted, soft and flexible, fragrant with a balsamic odor, closely serrulate, acute with short callous points, lustrous, pale yellow-green when they first emerge from the buds, but dark gray-green during their first summer, stomatiferous with many rows of minute stomata, from an inch and a half to three inches but usually about two inches in length and a twelfth of an inch in breadth; they contain two fibro-vascular bundles, usually two resin ducts, and strengthening

cells in one or two layers under the epidermis,[1] and fall gradually and irregularly during their third and fourth years. The staminate flowers are produced in crowded clusters, and are oblong and about one third of an inch in length, with orange-brown anthers terminating in semiorbicular fimbriate crests, and are surrounded by eight involucral bracts. The pistillate flowers are produced near the middle of the shoot of the year, generally a little below and alternate with one or two lateral branchlets, and are borne on long opposite spreading or somewhat ascending peduncles covered by chestnut-brown bracts, those of the inner ranks being scarious on the margins and much reflexed; they are subglobose, with ovate pale green scales narrowed into long slender slightly recurved tips tinged with rose-color, and with large orbicular bracts. The cones during their first winter are oblong, dark red-brown, and from one half to three quarters of an inch in length, and when fully grown are oblong-conical, often curved, dark green and lustrous, with the exception of the bright red-brown umbos and prickles, and from two to three inches but usually about two inches and a half long and from an inch to an inch and a quarter thick, with thin nearly flat scales rounded at the apex, their exposed portions being only slightly thickened and conspicuously transversely keeled, with small dark elevated umbos armed with stout or slender persistent prickles; opening in the autumn, the cones slowly shed their seeds, and, turning dark reddish brown on the exposed portions and dull red on the others, often remain on the branches for three or four years longer. The seeds are nearly oval, full and rounded, slightly ridged, and a quarter of an inch in length, with a thin pale brown rugose coat and an embryo usually with five cotyledons; their wings are broadest at the middle, dark chestnut-brown, lustrous, striate, one third of an inch long and about one eighth of an inch wide.

Pinus Virginiana is distributed from Middle Island, Long Island, and Clifton, Staten Island, New York, southward generally near the coast to the valley of the Savannah River in central Georgia and to northeastern Alabama,[2] and through eastern and middle Tennessee and Kentucky[3] to southeastern Indiana.[4] Usually small in the Atlantic states, where it grows only on light sandy soil and, especially in Maryland and Virginia, spreads rapidly over fields exhausted by agriculture, it attains its greatest size west of the Alleghany Mountains, frequently rising on the low hills or knobs of southern Indiana to the height of over one hundred feet.

The wood of *Pinus Virginiana* is light, soft, not strong, brittle, close-grained, and durable in contact with the soil; it is light orange-color, with thick nearly white sapwood, and contains broad conspicuous resinous bands of small summer cells, few resin passages, and many thin medullary rays. The specific gravity of the absolutely dry wood is 0.5309, a cubic foot weighing 33.09 pounds. In the country watered by the lower Potomac and James Rivers it is generally employed for fuel,[5] and in Kentucky and Indiana it is sometimes manufactured into lumber and is also largely used for water-pipes and pump-logs; in Indiana tar was formerly obtained by burning the wood of this tree.

The earliest account of *Pinus Virginiana*[6] was published by Plukenet in 1696;[7] and in 1739 it was cultivated by Philip Miller[8] in the Physic Garden in Chelsea near London.[9] It is hardy and ripens its seeds in eastern Massachusetts, but as an ornamental tree *Pinus Virginiana* has nothing to recommend it, its chief value consisting in its ability to cover rapidly sterile and worn-out soils in the middle Atlantic states.

[1] Coulter & Rose, *Bot. Gazette*, xi. 308.

[2] In July, 1881, *Pinus Virginiana* was found by Dr. Charles Mohr on rocky heights and hillsides, at an elevation of one thousand and sixty-three feet above the sea, near Gadsden, Etowah County, Alabama.

[3] In Tennessee *Pinus Virginiana* ranges west to the valley of the Tennessee River in Hardin County, and occurs on the elevated rolling hills of Stewart County; and in Kentucky it is common in Boyle and Mercer, Barren and Edmonson Counties, in the northern part of Christian County, and on Piney Creek in Trigg County.

[4] In Indiana *Pinus Virginiana* extends northward to the Silver Hills in the southwestern part of Scott County, near the line of Clarke County and about twenty-five miles north of the Ohio River, and spreads along all the crests of the knobs almost to Vienna in Scott County.

[5] Ruffin, *Russell's Magazine*, iv. 37.

[6] *Pinus Virginiana* is also sometimes called Cedar Pine and River Pine. (See Ruffin, *l. c.*)

[7] *Pinus Virginiana binis brevioribus & crassioribus setis, minori cono, singulis squamarum capitibus aculeo donatis, Alm. Bot.* 297. — Ray, *Hist. Pl.* iii.; *Dendr.* 8.

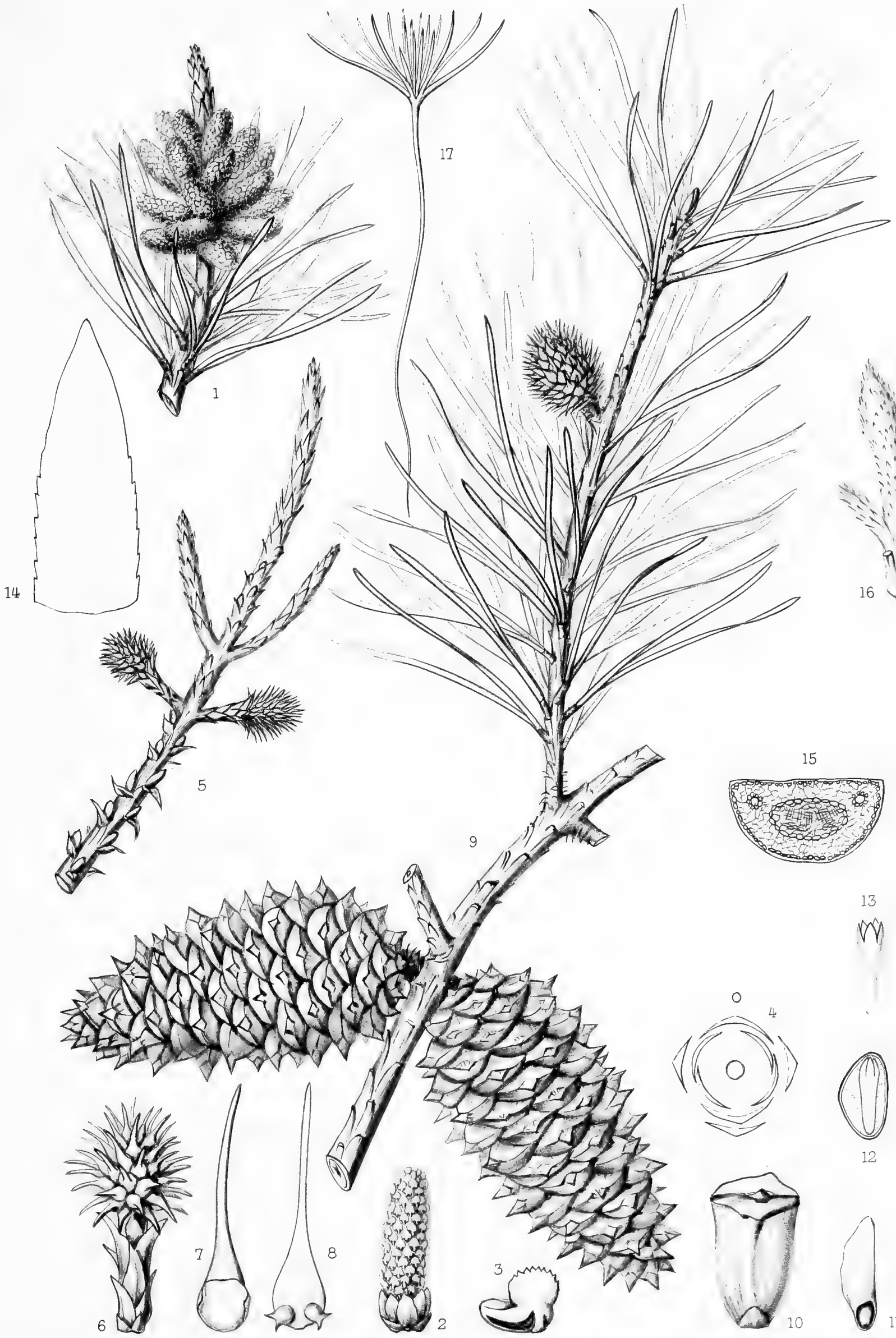
[8] See i. 38.

[9] Loudon, *Arb. Brit.* iv. 2192, f. 2068–2071.

EXPLANATION OF THE PLATE.

Plate DLXXXI. Pinus Virginiana.

1. A flowering branch with staminate flowers, natural size.
2. A staminate flower, enlarged.
3. An anther, enlarged.
4. Diagram of the involucre of the staminate flower.
5. An end of a branch with pistillate flowers, natural size.
6. A pistillate flower, enlarged.
7. A scale of a pistillate flower, lower side, with its bract, enlarged.
8. A scale of a pistillate flower, upper side, with its ovules, enlarged.
9. A fruiting branch, natural size.
10. A cone-scale, lower side, with its bract, enlarged.
11. A seed, enlarged.
12. Vertical section of a seed, enlarged.
13. An embryo, enlarged.
14. Tip of a leaf, enlarged.
15. Cross section of a leaf, magnified fifteen diameters.
16. Expanding branch-buds, natural size.
17. A seedling plant, natural size.



C.E.Faxon del. *Em.Himely sc.*

PINUS VIRGINIANA, Mill.

A.Riocreux direx.t *Imp. J. Taneur, Paris.*

PINUS CLAUSA.

Sand Pine. Spruce Pine.

LEAVES in 2-leaved clusters, slender, flexible, dark green, from 2 to $3\frac{1}{2}$ inches in length. Cones ovoid-conical, often recurved, serotinous, persistent for many years, their scales armed with short stout straight or recurved spines.

Pinus clausa, Sargent, *Forest Trees N. Am. 10th Census U. S.* ix. 199 (1884). — Mayr, *Wald. Nordam.* 116, t. 8, f. — Sudworth, *Garden and Forest*, v. 160, f. 24. — Masters, *Jour. R. Hort. Soc.* xiv. 227. — Hansen, *Jour. R. Hort. Soc.* xiv. 356 (*Pinetum Danicum*).

Pinus inops, var. **clausa**, Engelmann, *Bot. Gazette*, ii. 125 (1877); *Trans. St. Louis Acad.* iv. 183. — Chapman, *Fl.* ed. 2, Suppl. 650. — Beissner, *Handb. Nadelh.* 216.

A tree, on the sandy dunes of the Florida coast usually fifteen or twenty feet tall, with a stem rarely a foot in diameter, generally clothed to the ground with wide-spreading slender branches which form a bushy frequently flat-topped head, or sometimes in more favorable positions rising to the height of seventy or eighty feet, with a trunk two feet in diameter. The bark on the lower part of the trunk is from one third to one half of an inch in thickness, and is deeply divided by narrow fissures into irregularly shaped but generally oblong plates separating on the surface into thin closely appressed bright red-brown scales, and on the upper part and on the branches it is thin, smooth, and ashy gray. The winter branch-buds are oblong-cylindrical and rather abruptly narrowed at the full and rounded apex, rarely more than a quarter of an inch long, and covered by dark chestnut-brown lustrous scales clothed on the margins with pale matted hairs, those of the inner ranks soon becoming reflexed and separating from their bases, which continue for three or four years to mark the branches. These are slender, tough, and flexible, and are glabrous and pale yellow-green when they first appear, and rather bright red-brown during their first winter, becoming light orange-brown during their second year, and then gradually turning ashy gray. The leaves are borne in clusters of two, with sheaths which at first are loose, light chestnut-brown, and from an eighth to nearly a quarter of an inch in length, but before the end of the first season become thick and dark brown, with loose scarious margins, and less than an eighth of an inch long; they fall with the leaves during their third and fourth years; the leaves are flexible, serrulate, acute with short callous tips, stomatiferous with from ten to twenty rows of stomata, dark green, from two to two and a half inches long, and generally not more than one thirty-second but occasionally one twenty-fourth of an inch wide; they contain two fibro-vascular bundles, and usually two resin ducts, one of which is frequently internal, and which are without strengthening cells, although these are occasionally scattered in the epidermal region.[1] The staminate flowers are produced in short crowded spikes, and are cylindrical, about a third of an inch long and an eighth of an inch thick, with dark orange-colored anthers terminating in orbicular nearly entire or denticulate crests, and are surrounded by involucres of ten or eleven bracts. The pistillate flowers are lateral, from subglobose to oblong, with ovate acute scales gradually narrowed into long slender straight slightly spreading tips, and are raised on stout peduncles about a quarter of an inch in length and covered by dark chestnut-brown lustrous bracts scarious on the margins. During their first winter the cones are horizontal on stout peduncles, and are about half an inch long with sharp incurved spines, and when fully grown in the following autumn they are ovoid-conical, often oblique at the base, usually clustered and reflexed, dark green with the exception of the dark red-brown umbos and spines, from two to three and a half

[1] Coulter & Rose, *Bot. Gazette*, xi. 308.

inches long, from an inch to an inch and a quarter wide, and nearly sessile or short-stalked, with concave scales rounded at the apex, their exposed portions being conspicuously transversely keeled and thickened into central knobs terminating in elevated transversely flattened umbos armed with short stout straight or recurved spines which mostly disappear before the cones open; turning dark reddish brown, some of the cones open as soon as they are ripe, some remain closed for three or four years before liberating their seeds, ultimately turning to an ashy gray color, and others, while still unopened, become in time enveloped by the growing tissues of the trunk or branches, which finally cover them unless fire in killing the tree opens their scales and scatters their seeds. The seeds are nearly triangular, compressed, and about a quarter of an inch long, with a black slightly tuberculate coat and an embryo with from four to six cotyledons; their wings are thin and fragile, widest near or below the middle, dark red-brown, lustrous, three quarters of an inch long and about one quarter of an inch wide.

Pinus clausa, which was first noticed in 1846 near Apalachicola, Florida,[1] by Dr. A. W. Chapman,[2] is distributed along the coast of the Gulf of Mexico from southeastern Alabama[3] to the shores of Pease Creek, Florida, seldom extending thirty miles inland; and in east Florida, from the neighborhood of St. Augustine to Halifax River, it occupies a narrow belt rarely more than a mile wide parallel with and not far from the coast, and ranges southward on sandy ridges to below Jupiter Inlet, where it covers sandy wind-swept plains. On the Gulf coast it is common on the sand dunes of Pensacola Bay, on the shores of Santa Rosa Sound and Choctawhatchee Bay and on Cedar Keys, and flourishes on pure white drifting sands, although it is rarely more than twenty feet high, and bent low in the direction of the prevailing winds is often nearly prostrate; farther inland, on the dry ridges in the neighborhood of Pensacola and on uplands of better quality, where it grows with Magnolias, Hickories, Live Oaks, and Post Oaks, it is more vigorous, and often of a large size, probably attaining, however, its greatest development on the east coast near the head of Halifax River, where trees from seventy to eighty feet high, with trunks two feet in diameter, are abundant.[4]

The wood of *Pinus clausa* is light, soft, not strong, and brittle; it is light orange-color or yellow, with thick nearly white sapwood, and contains broad very resinous conspicuous bands of small summer cells, numerous prominent resin passages, and many thin medullary rays. The specific gravity of the absolutely dry wood is 0.5576, a cubic foot weighing 34.75 pounds.[5]

The stems are occasionally used for the masts of small vessels. The chief value of *Pinus clausa* consists, however, in its ability to grow rapidly on the barren sands of the hot southern coast, and this tree will probably be found useful if it ever becomes necessary to protect their shifting surface with a forest-covering.

[1] The *Pinus Abies Virginiana, conis parvis subrotundis*, or the balm of *Gilead* pine which Bernard Romans saw on the coast of West Florida in December, 1771, is perhaps this species. (See *Nat. Hist. Florida*, 317.)

[2] See vii. 110.

[3] The most westerly station for this tree noticed by Dr. Charles Mohr is between Bon Secour and Perdido Bay in the extreme southeastern part of Baldwin County, Alabama.

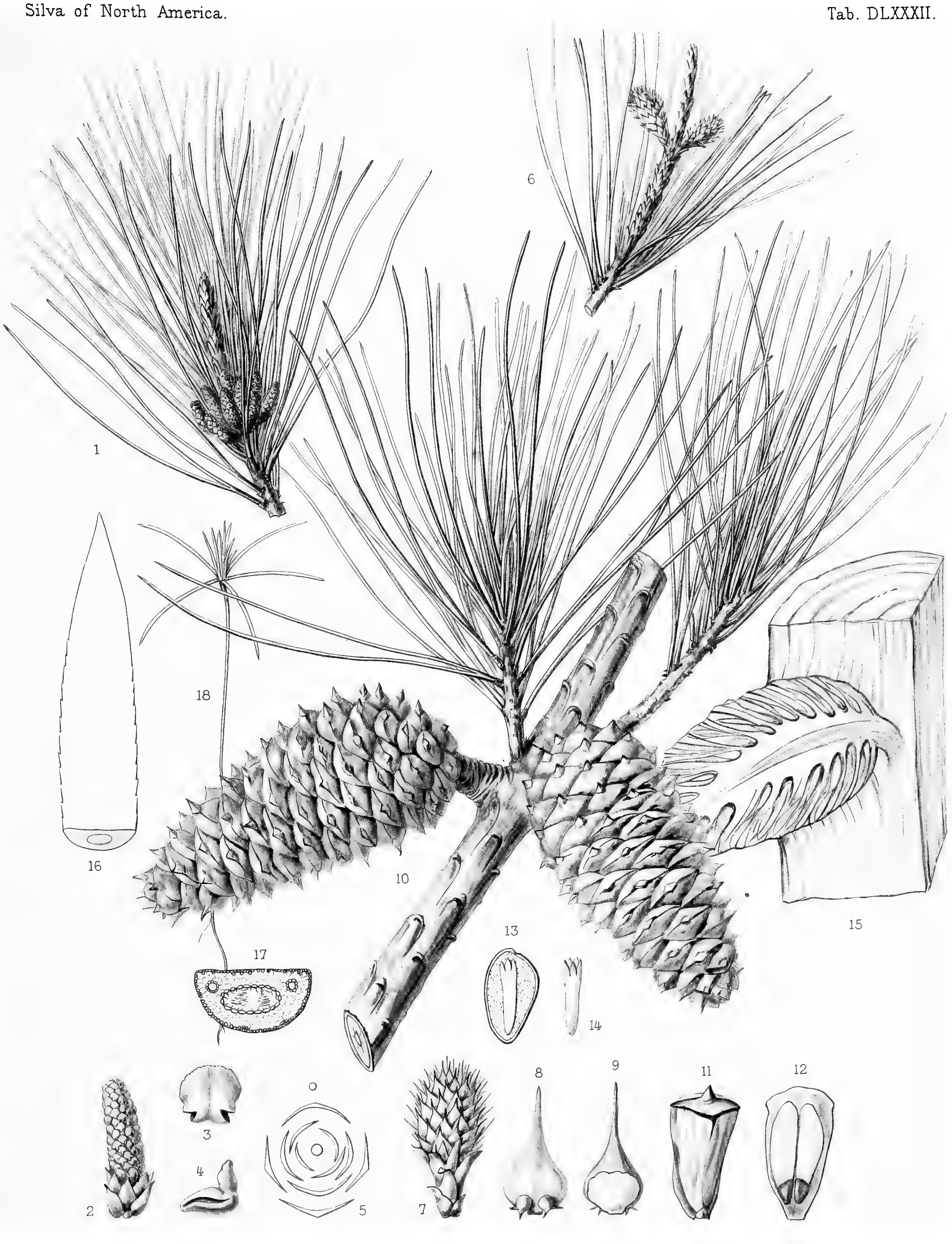
[4] Mohr, *Garden and Forest*, iii. 402.

[5] *Pinus clausa* grows very rapidly even in pure sand. The log specimen in the Jesup Collection of North American Woods in the American Museum of Natural History, New York, is thirteen inches and a half in diameter inside the bark, and only thirty-nine years old, its sapwood being two inches and one eighth in thickness, with sixteen layers of annual growth.

EXPLANATION OF THE PLATE.

PLATE DLXXXII. PINUS CLAUSA.

1. A branch with staminate flowers, natural size.
2. A staminate flower, enlarged.
3. An anther, front view, enlarged.
4. An anther, side view, enlarged.
5. Diagram of the staminate flower.
6. A branch with pistillate flowers, natural size.
7. A pistillate flower, enlarged.
8. A scale of a pistillate flower, upper side, with its ovules, enlarged.
9. A scale of a pistillate flower, lower side, with its bract, enlarged.
10. A fruiting branch, natural size.
11. A cone-scale, natural size.
12. A cone-scale, upper side, with its seeds, natural size.
13. Vertical section of a seed, enlarged.
14. An embryo, enlarged.
15. Section of an imbedded cone, natural size.
16. Tip of a leaf, enlarged.
17. Cross section of a leaf, magnified fifteen diameters.
18. A seedling plant, natural size.



C.E.Faxon del. *Himely sc.*

PIŃUS CLAUSA, Sarg.

A.Riocreux direx.t *Imp.J Taneur, Paris.*

PINUS GLABRA.

Spruce Pine. Cedar Pine.

LEAVES in 2-leaved clusters, soft, slender, dark green, from $1\frac{1}{2}$ to 3 inches in length. Cones subglobose to oblong-ovate, from $1\frac{1}{4}$ to 2 inches long, their scales thin, tipped with straight or incurved short often deciduous prickles.

Pinus glabra, Walter, *Fl. Car.* 237 (1788). — Poiret, *Lamarck Dict.* v. 342. — Chapman, *Fl.* 433. — Hoopes, *Evergreens*, 82. — Engelmann, *Trans. St. Louis Acad.* iv. 184. — Sargent, *Forest Trees N. Am. 10th Census U. S.* ix. 200. — Mohr, *Garden and Forest*, iii. 295; *Bull.* No. 13, *Div. Forestry U. S. Dept. Agric.* 125 (*The Timber Pines of the Southern U. S.*). — Mayr, *Wald. Nordam.* 117, t. 8, f. — Masters, *Jour. R. Hort. Soc.* xiv. 229.

Pinus mitis, β **paupera**, Wood, *Cl. Book*, 660 (1869).

A tree, usually from eighty to one hundred or occasionally one hundred and twenty feet in height, with a trunk from two to two and a half or rarely three and a half feet in diameter, and free of branches for fifty or sixty feet, comparatively small horizontal limbs divided into branches and branchlets spreading at right angles, and numerous lateral roots extending from a weak tap-root for some distance close to the surface before they penetrate deep into the soil. The bark of the trunk is from one half to three quarters of an inch in thickness and slightly and irregularly divided by shallow fissures into flat connected ridges, and is broken into small closely appressed light reddish brown scales. The winter branch-buds are ovate, acute, about one quarter of an inch long and one sixteenth of an inch thick, and are covered with ovate lanceolate dark chestnut-brown scales separating on the margins into numerous white matted shreds, those of the inner ranks mostly disappearing during the first winter and leaving their rather prominent somewhat thickened bases to roughen the branches for several years. The branchlets, which are slender and glabrous, when they first appear are flaccid, light red more or less tinged with purple, and during their first winter they are light reddish brown, and then gradually grow darker and are often furnished with short lateral leafy branchlets from adventitious buds. The leaves are borne in clusters of two, with sheaths which at first are light chestnut-brown below, scarious above, and from one third to nearly one half of an inch long, but before the end of the summer become close, nearly black, and about an eighth of an inch in length, with loose ragged margins, and are persistent with the leaves, which fall partly at the end of their second season and partly in the following spring; the leaves are soft, flexible, serrulate, acuminate with long sharp callous points, dark green, and from an inch and a half to three inches long and nearly one sixteenth of an inch wide, and contain two fibro-vascular bundles and usually two or three resin ducts, one being often internal, and strengthening cells scattered under the epidermis.[1] The staminate flowers are produced in short crowded clusters and are cylindrical, from one half to three quarters of an inch long and about one eighth of an inch thick, with yellow anthers terminating in orbicular denticulate crests, and are surrounded by an involucre of ten or twelve bracts membranaceous and lacerate on the margins, the lowest pair being much smaller than the others. The pistillate flowers are lateral, being commonly produced at some distance below the end of the branchlet, and are raised on slender slightly ascending peduncles covered by dark chestnut-brown lustrous bracts scarious and often torn on the margins; they are subglobose and about a quarter of an inch long, with broadly ovate scales gradually narrowed into short stout tips, and elliptical bracts. The cones during their first winter are oblong, erect or slightly spreading, not often more than one third of an inch in length, and

[1] Coulter & Rose, *Bot. Gazette*, xi. 308.

dark brown and lustrous, their scales being armed with slender straight or incurved spines; when fully grown in the autumn they are single or in clusters of two or of three, reflexed on short stout peduncles, from subglobose to oblong-ovate, dark green, from an inch and a half to two inches long and about three quarters of an inch thick, with thin slightly concave scales rounded at the apex, their exposed portions, which are only slightly thickened and inconspicuously transversely keeled, terminating in small dark flat umbos armed with minute straight or incurved usually deciduous prickles; they are reddish brown and rather lustrous, and dark purple on the upper side of the base of the scales when they open and shed their seeds in the autumn, and remain on the branches for two or three years longer. The seeds are nearly triangular, full and rounded on the sides, somewhat roughened and ridged below, and about an eighth of an inch in length, with a thin dark gray coat mottled with black and an embryo with five or six cotyledons; their wings are thin and fragile, broadest below the middle, dark brown and lustrous, about five eighths of an inch long and a quarter of an inch wide.[1]

Pinus glabra is distributed from the valley of the lower Santee River in South Carolina to middle and northwestern Florida and to the valley of Pearl River in eastern Louisiana, being usually found only in the neighborhood of the coast, where it grows, singly or in small colonies, on low terraces which rise above river-swamps subject to frequent overflow, and where it is associated with Magnolias, Gums, Hickories, and Beeches, and with the short-leaved and Loblolly Pines, flourishing while young in their dense shade, but finally pushing its stately crown into the light above its associates; it is comparatively rare except in the region between the Chatahoochee and the Choctawhatchee Rivers in northwestern Florida, where it probably attains its greatest size and often covers areas of considerable extent, soon occupying abandoned clearings in the forest.

One of the largest of the Pine-trees of eastern North America, *Pinus glabra* has little economic value, although it is occasionally cut for fuel and the saw-mill.[2] The wood is light, soft, not strong, brittle, very close-grained, and not durable; it is light brown, with thick nearly white sapwood, and contains broad bands of small summer cells, few rather small resin passages, and many obscure medullary rays. The specific gravity of the absolutely dry wood is 0.3931, a cubic foot weighing 24.50 pounds.

Pinus glabra appears to have been first noticed by Thomas Walter[3] who published the earliest description of it in 1788. Long overlooked by later botanists, it was not recognized again until three quarters of a century later, when an account of it was published[4] by Mr. H. W. Ravenel,[5] who found it near Walter's original locality.

[1] *Pinus glabra* begins to produce flowers and seeds at the age of twelve or fifteen years, being most prolific from its twentieth to its fortieth year. The seeds germinate in the fall or at the beginning of the following spring, the seedlings being often six inches high early in April. Trees twenty years old are generally from thirty to thirty-five feet tall, with stems from four to four and a half inches in diameter, and usually attain their full growth at the age of from sixty to seventy-five years (Mohr, *Bull.* No. 13, *Div. Forestry U. S. Dept. Agric.* 129 [*The Timber Pines of the Southern U. S.*]).

[2] See Mellichamp, *Garden and Forest*, ii. 15.

[3] Little is known of Thomas Walter, the author of the *Flora Caroliniana*, published in London in 1788. He was a native of Hampshire, in England, and for many years a resident of St. John's Parish, South Carolina, where he had a plantation on the banks of the Santee River, and where he died in 1788, at the age of about forty-eight years, being buried at his own request in his garden, where he had cultivated many of the plants described in his *Flora*. These meagre facts were gathered nearly fifty years ago by Mr. Ravenel, from his tombstone erected by his only surviving children, Ann and Mary. (See Ravenel, *Proc. Elliott Soc.* i. 53. — See also F. A. Porcher, *Southern Quarterly Review*, 1854 [*History and Social Sketch of Craven County, So. Carolina*].) Walter's herbarium is preserved in the British Museum.

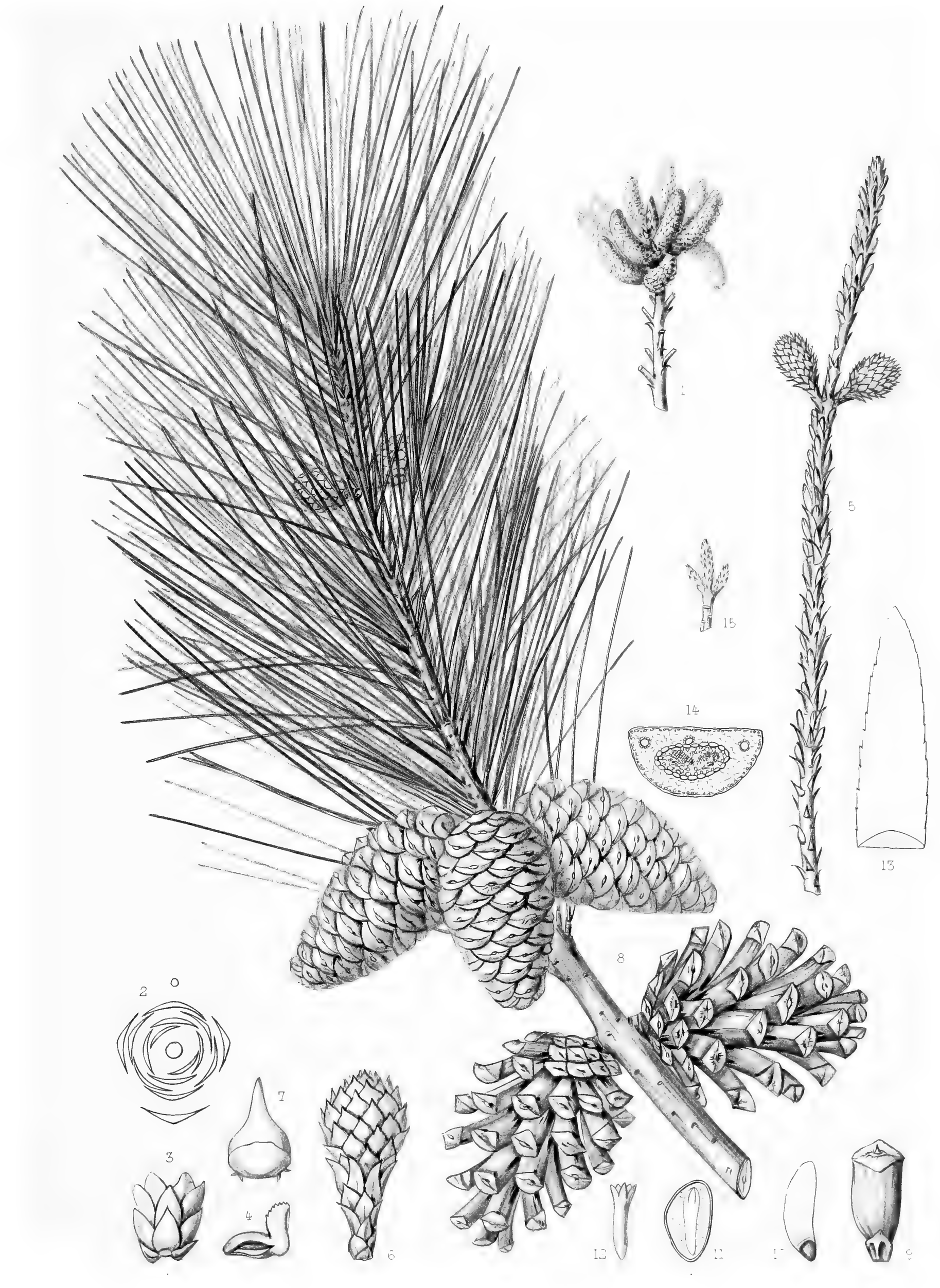
[4] Ravenel, *l. c.* 51.

[5] See viii. 160.

EXPLANATION OF THE PLATE.

PLATE DLXXXIII. PINUS GLABRA.

1. A cluster of staminate flowers, natural size.
2. Diagram of the involucre of the staminate flower.
3. An involucre of a staminate flower, enlarged.
4. An anther, side view, enlarged.
5. An end of a branch with pistillate flowers, natural size.
6. A pistillate flower, enlarged.
7. A scale of a pistillate flower, lower side, with its bract, enlarged.
8. A fruiting branch, natural size.
9. A cone-scale, lower side, with its bract, natural size.
10. A seed, natural size.
11. Vertical section of a seed, enlarged.
12. An embryo, enlarged.
13. Tip of a leaf, enlarged.
14. Cross section of a leaf, magnified fifteen diameters.
15. Winter branch-buds, natural size.



C.E.Faxon del. Em.Himely sc.

PINUS GLABRA, Walt.

A.Riocreux direx.t Imp. J.Taneur, Paris.

PINUS PUNGENS.

Table-Mountain Pine. Hickory Pine.

LEAVES in 2-leaved clusters, stout, blue-green, from $1\frac{1}{4}$ to $2\frac{1}{2}$ inches in length. Cones oblong-conical, oblique, from 2 to $3\frac{1}{2}$ inches long, their scales armed with stout hooked spines.

Pinus pungens, Michaux f. *Hist. Arb. Am.* i. 61, t. 5 (1810). — *Nouveau Duhamel*, v. 236, t. 67, f. 4. — Pursh, *Fl. Am. Sept.* ii. 643. — Poiret, *Lamarck Dict.* Suppl. iv. 416. — Elliott, *Sk.* ii. 635. — Sprengel, *Syst.* iii. 886. — Lawson & Son, *Agric. Man.* 347; *List No. 10, Abietineæ*, 41. — D. Don, *Lambert Pinus*, iii. t. — Forbes, *Pinetum Woburn.* 17, t. 5. — Antoine, *Conif.* 18, t. 5, f. 4. — Nuttall, *Sylva*, iii. 125. — Spach, *Hist. Vég.* xi. 387. — Endlicher, *Syn. Conif.* 166. — Knight, *Syn. Conif.* 27. — Lindley & Gordon, *Jour. Hort. Soc. Lond.* v. 217. — Dietrich, *Syn.* v. 399. — Carrière, *Traité Conif.* 359. — Gordon, *Pinetum*, 181. — Courtin, *Fam. Conif.* 87. — Chapman, *Fl.* 432. — Curtis, *Rep. Geolog. Surv. N. Car.* 1860, iii. 20. — Henkel & Hochstetter, *Syn. Nadelh.* 21. — (Nelson) Senilis, *Pinaceæ*, 127. — Hoopes, *Evergreens*, 98, f. 13. — Sénéclauze, *Conif.* 140. — Parlatore, *De Candolle Prodr.* xvi. pt. ii. 379. — K. Koch, *Dendr.* ii. pt. ii. 304. — Meehan, *Rep. Penn. Fruit Growers' Soc.* 1877, t. — Engelmann, *Trans. St. Louis Acad.* iv. 183. — Veitch, *Man. Conif.* 158. — Sargent, *Forest Trees N. Am.* 10*th Census U. S.* ix. 199. — Lauche, *Deutsche Dendr.* ed. 2, 109. — Schübeler, *Virid. Norveg.* i. 393. — Watson & Coulter, *Gray's Man.* ed. 6, 491. — Mayr, *Wald. Nordam.* 192, t. 8, f. — Beissner, *Handb. Nadelh.* 214, f. 56. — Masters, *Jour. R. Hort. Soc.* xiv. 238. — Hansen, *Jour. R. Hort. Soc.* xiv. 385 (*Pinetum Danicum*). — Koehne, *Deutsche Dendr.* 37. — Britton & Brown, *Ill. Fl.* i. 53, f. 117.

Pinus montana, Noll, *The Botanical Class-Book and Flora of Penn.* 340 (not Miller, Lambert, nor Hoffman) (1852).

A tree, when crowded by its neighbors in the forest occasionally sixty feet in height, with a trunk two or three feet in diameter, and a few short branches near the summit forming a narrow round-topped head; or in open ground usually twenty or thirty feet tall, and often fertile when only a few feet high, with a short thick trunk frequently clothed to the ground with long stout horizontal branches, the lower pendulous toward the extremities, and the upper sweeping upward in graceful curves and forming a broad open flat-topped and often very irregular head. The bark on the lower part of the trunk is from three quarters of an inch to nearly an inch in thickness, and is broken into irregularly shaped plates separating on the surface into thin loose dark brown scales tinged with red; higher on the stem and on the branches it is dark brown broken into thin loose scales. The winter branch-buds are narrowed from the middle to the ends, and rather obtuse at the apex, the terminal bud being half an inch long and nearly a quarter of an inch broad and usually two or three times larger than the lateral buds; their scales are ovate, lustrous, dark chestnut-brown, and scarious on the margins, and soon becoming reflexed on the lengthening shoots gradually disappear and leave their dark bases to roughen the branches for many years. The branchlets, which are stout and glabrous, when they first appear are light orange-color, and growing darker during their first year, become tinged with purple, especially on the upper side, in the following season, and then slowly turn dark brown. The leaves are borne in crowded clusters of two, with sheaths which at first are thin and scarious, light chestnut-brown, and about three eighths of an inch long, but before the end of the season become little more than an eighth of an inch in length, thick and nearly black, with a loose lacerated margin, and are persistent with the leaves, which fall irregularly during their second and third years; the leaves are rigid, usually twisted, finely serrulate, sharp-pointed with short callous tips, dark blue-green, from an inch and a quarter to two inches and a half long and about a sixteenth of an inch wide; they contain two fibro-vascular bundles, from two to five parenchymatous resin ducts, some of them smaller than the others and often

internal, and strengthening cells in small bundles under the epidermis and between the numerous rows of stomata.[1] The staminate flowers are produced in elongated loose spikes, and are oblong and about a third of an inch long and an eighth of an inch thick, with yellow anthers terminating in orbicular denticulate crests, and are surrounded by about eight involucral bracts. The pistillate flowers are clustered, lateral, and subglobose or oblong, with ovate scales narrowed into elongated slender tips, and large orbicular bracts, and are raised on stout peduncles a third of an inch in length and covered by broadly ovate acute light chestnut-brown bracts scarious on the margins. The cones, which become horizontal soon after the fertilization of their ovules, during the first winter are subglobose and about an inch in length, with elongated stout incurved spines, and when fully grown in the following autumn they are oblong-conical, oblique at the base by the greater development of the scales on the upper than on the lower side, sessile, deflexed, in clusters usually of three or four or rarely of seven or eight, from two to three and a half inches long and about two inches thick, and light green, turning when fully ripe light brown and lustrous, with thin tough scales; these are dark dull purple on the lower side and mahogany-red on the upper, their exposed portions, which are armed with stout hooked spines incurved above the middle of the cone and recurved below it, being conspicuously transversely keeled, on the inner side of the cone slightly thickened and on the outer, especially near the base, produced into much thickened mammillate knobs; the cones sometimes open as soon as they are ripe, and gradually shed their seeds, or often remain closed for two or three years longer, and frequently do not fall from the branches until the end of eighteen or twenty years. The seeds are almost triangular, full and rounded on the sides, and nearly a quarter of an inch in length, with a thin conspicuous rugose light brown coat and an embryo usually with six cotyledons; their wings are thin and fragile, widest below the middle, gradually narrowed to the ends, pale, lustrous, and marked with narrow red-brown streaks.

Pinus pungens usually grows on dry gravelly slopes and ridges of the Appalachian Mountains from Pennsylvania[2] to North Carolina and eastern Tennessee, sometimes ascending to elevations of three thousand feet above the sea-level, with isolated outlying stations in Virginia,[3] eastern Pennsylvania, and western New Jersey,[4] and often forms toward the southern limits of its range nearly pure forests of considerable extent.

The wood of *Pinus pungens* is light, soft, not strong, brittle, and very coarse-grained. It is pale brown, with thick nearly white sapwood, and contains broad conspicuous resinous bands of small summer cells, numerous large resin passages, and many prominent medullary rays. The specific gravity of the absolutely dry wood is 0.4935, a cubic foot weighing 30.75 pounds.[5] It is somewhat used for fuel, and in Pennsylvania is manufactured into charcoal.

First distinguished by the French botanist Michaux,[6] *Pinus pungens* was introduced into English gardens in 1804.[7] Although as an ornamental tree it has little to recommend it but the beauty of its abundant massive cones, it is sometimes cultivated in the United States, and has proved hardy as far north as eastern Massachusetts and as far west as central Kansas.[8]

[1] Coulter & Rose, *Bot. Gazette*, xi. 307.

[2] In Pennsylvania *Pinus pungens* has been observed at Two Top on the east side of the Blue Mountain close to the Maryland line, at Fort Carbon on the Schuylkill River, and in the central part of the state, where it is abundant on the Tussey and Stone Mountain ranges in Blair, Huntingdon, Centre, Mifflin, and Union Counties, and in an isolated station at McCall's Ferry, Lancaster County, where it was found in 1892 by Mr. A. A. Heller. (See Porter, *Garden and Forest*, vi. 204.)

[3] In Virginia where *Pinus pungens* is common on the Blue Ridge, near Charlottesville, and on the Massanutten Mountains, it was found on June 17, 1794, between Alexander and Fredericksburg by the elder Michaux, who wrote a description of it in his Journal, alluding to the fact that he had previously seen the same tree on the Schuylkill River in Pennsylvania. (See Michaux, *Jour.* in *Proc. Am. Phil. Soc.* xxxvi. 104.)

[4] On May 15, 1886, R. E. Schuh and G. N. Best discovered a small grove of *Pinus pungens* one mile east of Sergeantsville, Delaware Township, Hunterdon County, New Jersey (*Bull. Torrey Bot. Club*, xiii. 121).

[5] *Pinus pungens* usually grows rapidly, although the log specimen in the Jesup Collection of North American Woods in the American Museum of Natural History, New York, which is eleven and one half inches in diameter inside the bark, is seventy-four years old. In this specimen the sapwood is two and seven eighths inches thick, with fifty-three layers of annual growth.

[6] See i. 58.

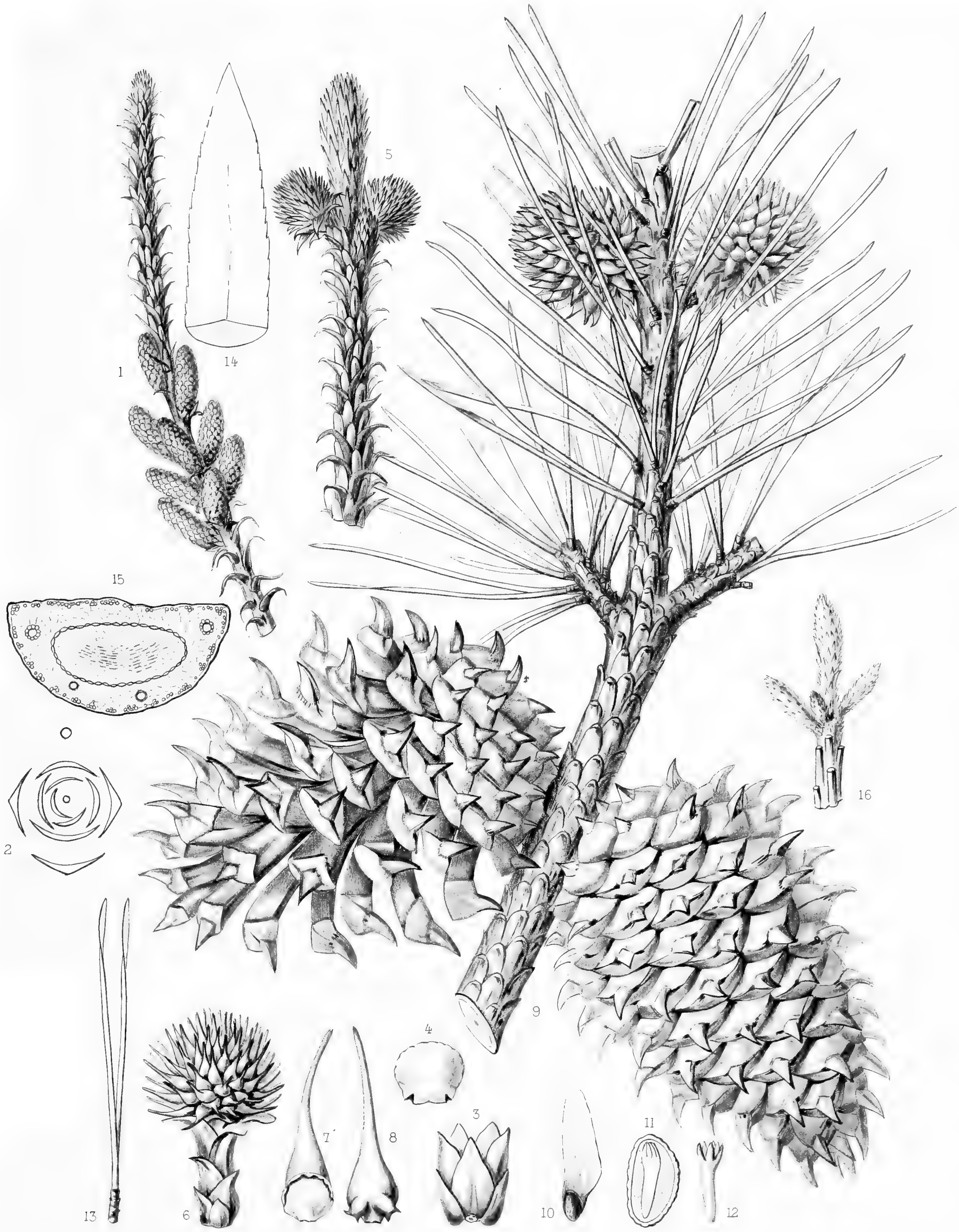
[7] Aiton, *Hort. Kew.* ed. 2, v. 314. — Loudon, *Arb. Brit.* iv. 2197, f. 2077–2080.

[8] Sears, *Garden and Forest*, ix. 462.

EXPLANATION OF THE PLATE.

PLATE DLXXXIV. PINUS PUNGENS.

1. An end of a branch with staminate flowers, natural size.
2. Diagram of the involucre of the staminate flower.
3. An involucre of a staminate flower, enlarged.
4. An anther, front view, enlarged.
5. An end of a branch with pistillate flowers, natural size.
6. A pistillate flower, enlarged.
7. A scale of a pistillate flower, lower side, with its bract, enlarged.
8. A scale of a pistillate flower, upper side, with its ovules, enlarged.
9. A fruiting branch, natural size.
10. A seed, natural size.
11. Vertical section of a seed, enlarged.
12. An embryo, enlarged.
13. A cluster of leaves, natural size.
14. Tip of a leaf, enlarged.
15. Cross section of a leaf, magnified fifteen diameters.
16. Expanding branch-buds, natural size.



C.E.Faxon del. Himely sc.

PINUS PUNGENS, Michx.F.

A Riocreux direx.t Imp. J.Taneur, Paris.

PINUS MURICATA.

Prickle-cone Pine.

LEAVES in 2-leaved clusters, rigid, dark green, from 4 to 6 inches in length. Cones ovate, oblique, serotinous, persistent, from 2 to $3\frac{1}{2}$ inches long, their scales armed with stout incurved spines.

Pinus muricata, D. Don, *Trans. Linn. Soc.* xvii. 441 (1837); *Lambert Pinus*, iii. t. — Loudon, *Arb. Brit.* iv. 2269, f. 2180. — Hooker & Arnott, *Bot. Voy. Beechey*, 393. — Antoine, *Conif.* 32, t. 14, f. 1. — Nuttall, *Sylva*, iii. 113. — Endlicher, *Syn. Conif.* 161. — Knight, *Syn. Conif.* 26. — Lawson & Son, *List No. 10, Abietineæ*, 32. — Gordon, *Jour. Hort. Soc. Lond.* iv. 216, f.; *Fl. des Serres*, v. 517[b], f.; *Pinetum*, 173; ed. 2, 246 (excl. syn. *Pinus Murrayana*). — Lindley & Gordon, *Jour. Hort. Soc. Lond.* v. 217. — Dietrich, *Syn.* v. 398. — Carrière, *Traité Conif.* 359. — Torrey, *Bot. Mex. Bound. Surv.* 209, t. 54 (*Pinus Edgariana* on plate). — Courtin, *Fam. Conif.* 78. — Henkel & Hochstetter, *Syn. Nadelh.* 60. — (Nelson) Senilis, *Pinaceæ*, 121. — Hoopes, *Evergreens*, 92. — Sénéclauze, *Conif.* 127. — Parlatore, *De Candolle Prodr.* xvi. pt. ii. 379. — K. Koch, *Dendr.* ii. pt. ii. 302. — Engelmann, *Trans. St. Louis Acad.* iv. 183; *Brewer & Watson Bot. Cal.* ii. 128. — Veitch, *Man. Conif.* 151. — Kellogg, *Trees of California*, 64. — Masters, *Gard. Chron.* n. ser. xxi. 49, f. 7–9; *Jour. R. Hort. Soc.* xiv. 235. — Sargent, *Forest Trees N. Am.* 10*th Census U. S.* ix. 199. — Lemmon, *Rep. California State Board Forestry*, ii. 77, 118 (*Pines of the Pacific Slope*); *West-American Cone-Bearers*, 43. — Steele, *Proc. Am. Pharm. Assoc.* 1889, 244 (*The Pines of California*). — Mayr, *Wald. Nordam.* 275, t. 8, f. — Beissner, *Handb. Nadelh.* 213. — Hansen, *Jour. R. Hort. Soc.* xiv. 378 (*Pinetum Danicum*). — Koehne, *Deutsche Dendr.* 37.

Pinus Edgariana, Hartweg, *Jour. Hort. Soc. Lond.* iii. 217, 226 (1848).

Pinus inops, var. ? Bentham, *Pl. Hartweg.* 337 (1857).

Pinus contorta, Bolander, *Proc. Cal. Acad.* iii. 227, 317 (not Loudon) (1866).

Pinus muricata, var. **Anthonyi**, Lemmon, *West-American Cone-Bearers*, 43 (1895).

A tree, usually forty or fifty feet but occasionally ninety feet in height, with a trunk from two to three feet in diameter, and stout spreading branches covered with dark scaly bark, in youth forming a regular pyramid and at maturity a handsome compact round-topped head of dark dense tufted foliage. The bark on the lower part of the trunk is frequently from four to six inches in thickness and is deeply divided into long narrow rounded ridges roughened with closely appressed dark purple or dark purplish brown scales.[1] The winter branch-buds are ovate, acute, and covered with scales, which toward the apex of the bud are light red-brown and closely appressed, and below are darker with free reflexed tips, and are clothed on the margins with matted pale hairs, the terminal bud being about a third of an inch long, an eighth of an inch thick, and nearly three times as large as the lateral buds; their inner scales, which are somewhat fimbriate on the margins and often an inch long when fully grown, become reflexed on the lengthening shoots and soon fall from their bases, which, growing thick and dark, roughen for many years the branches. These are stout and glabrous, and when they first appear are dark orange-green, turning orange-brown during their first summer and then gradually brown more or less tinged with purple. The leaves are borne in crowded clusters of two, with close firm sheaths at first pale chestnut-brown below, scarious and white above, and about two thirds of an inch long, and in their second year, when the leaves occasionally begin to fall, thick, dark, and not more than a quarter of an inch in length with loose broken margins; the leaves are rigid, serrulate, acute with short callous tips, dark yellow-green, from four to six inches long and about one twelfth of an inch wide, and contain two fibro-vascular bundles, from two to nine resin ducts, and strengthening cells under the epidermis, usually in two layers, interrupted by the numerous bands of stomata.[2] The staminate flowers, which are produced in elongated spikes, are oval and about a quarter of an inch long,

[1] See *Garden and Forest*, x. f. 30, where the character of the bark of this tree is well displayed.

[2] Coulter & Rose, *Bot. Gazette*, xi. 305.

with dark orange-colored anthers terminating in orbicular denticulate crests, and are surrounded by involucres of six or eight bracts, those of the outer rank being as long as the others. The pistillate flowers are lateral and whorled, two whorls being often produced on the shoot of the year; they are raised on short stout peduncles furnished with ovate acute dark chestnut-brown bracts, with broad white scarious margins, and are oblong and about a third of an inch in length, with ovate scales gradually narrowed into long slender slightly spreading tips, and large nearly orbicular bracts. The cones are erect during their first winter, when they are nearly three quarters of an inch long, with light brown scales narrowed into slightly spreading and incurved tips, and on attaining their full size in the following autumn they are ovate-oblong, oblique at the base, sessile, in clusters of three or five or sometimes of seven, from two to three and a half but usually about three inches in length, from an inch and a half to nearly two inches in thickness, and dark orange-green, with lustrous chestnut-brown umbos and spines, later becoming light chestnut-brown and lustrous; the exposed portions of the scales on the outside of the cone are much thickened, transversely flattened, and produced toward the base into stout mammillate incurved knobs, or sometimes are armed with stout flattened spur-like spines incurved above its middle and recurved toward its apex, and on the inside of the cone are slightly flattened, the small dark umbos being armed with stout or slender straight prickles; the cones often remain closed for several years and usually persist on the stem and branches during the entire life of the tree, but do not become imbedded in the wood, as their stems stretch and finally separate, leaving them held by the bark to be carried outward with the enlargement of the stem.[1] The seeds are nearly triangular, somewhat roughened and about a quarter of an inch long, with a thin nearly black rugose coat and an embryo with four or five cotyledons.

Pinus muricata inhabits the California coast from the neighborhood of Fort Bragg in Mendocino County southward, in localities usually widely separated, to Tomales Point north of the Bay of San Francisco, and from Monterey to San Luis Obispo County, growing also in Lower California on Cedros Island[2] and on the coast between Ensanado and San Quintan.[3] Attaining its largest size near the northern limits of its distribution, it is the characteristic Pine-tree of the Mendocino coast, flourishing on steep bluffs and bold headlands in the full sweep of the ocean spray, on sandy plains, which it covers with forests of slender crowded trees, sometimes ascending on the better soil of uplands to elevations of nearly two thousand feet, and growing also on cold clay barrens, which it disputes with *Pinus contorta* and *Cupressus Goveniana*. On Tomales Point it grows on the most barren soil close to the ocean, and a mile inland forms small groves on the summits of low hills and ridges, or is mingled in more sheltered positions with Live Oaks, the Douglas Spruce, the Umbellularia, and the Madroña, attaining here a height of forty or fifty feet, with a short trunk often two and a half feet in diameter.

The wood of *Pinus muricata* is light, very strong, hard, and rather coarse-grained; it is light brown, with thick nearly white sapwood, and contains broad resinous bands of small summer cells, few inconspicuous resin passages, and many thin medullary rays. The specific gravity of the absolutely dry wood is 0.4942, a cubic foot weighing 38.80 pounds.[4] In Mendocino County it is occasionally manufactured into lumber.

Pinus muricata was discovered in 1831 by Dr. Thomas Coulter, in the neighborhood of San Luis Obispo, about thirty miles from the coast and nearly three thousand feet above the level of the sea, and in 1846 was introduced by Karl Theodor Hartweg into the gardens of Europe, where it is still occasionally cultivated,[5] its handsome compact head of dark foliage and its abundant cones making it a desirable feature for the parks and gardens of temperate regions.

[1] Lemmon, *Erythea*, ii. 160.

[2] Greene, *Pittonia*, i. 197, 207.

[3] In 1889 *Pinus muricata* was found by Mr. A. W. Anthony on the coast of Lower California.

[4] *Pinus muricata* grows rapidly even on barren soil. The log specimen in the Jesup Collection of North American Woods, in the American Museum of Natural History, New York, is fifteen and one half inches in diameter inside the bark, and seventy-six years old, with twenty-seven layers of sapwood which is three and a quarter inches thick.

[5] Fowler, *Gard. Chron.* 1872, 1164.

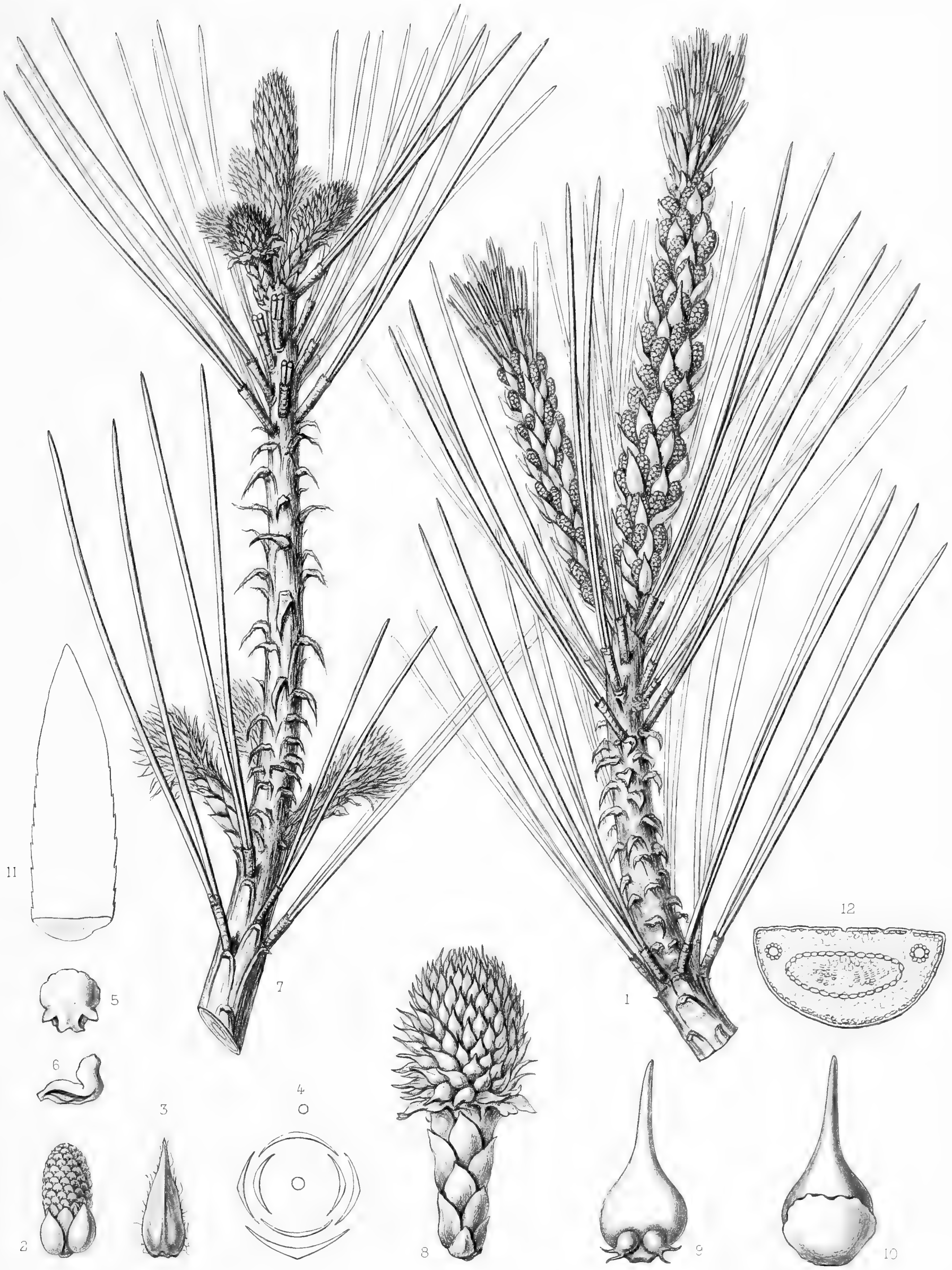
EXPLANATION OF THE PLATES.

PLATE DLXXXV. PINUS MURICATA.

1. A branch with staminate flowers, natural size.
2. A staminate flower, enlarged.
3. A bract of a staminate flower, enlarged.
4. Diagram of the involucre of the staminate flower.
5. An anther, front view, enlarged.
6. An anther, side view, enlarged.
7. A branch with pistillate flowers, natural size.
8. A pistillate flower, enlarged.
9. A scale of a pistillate flower, upper side, with its ovules, enlarged.
10. A scale of a pistillate flower, lower side, with its bract, enlarged.
11. Tip of a leaf, enlarged.
12. Cross section of a leaf, magnified fifteen diameters.

PLATE DLXXXVI. PINUS MURICATA.

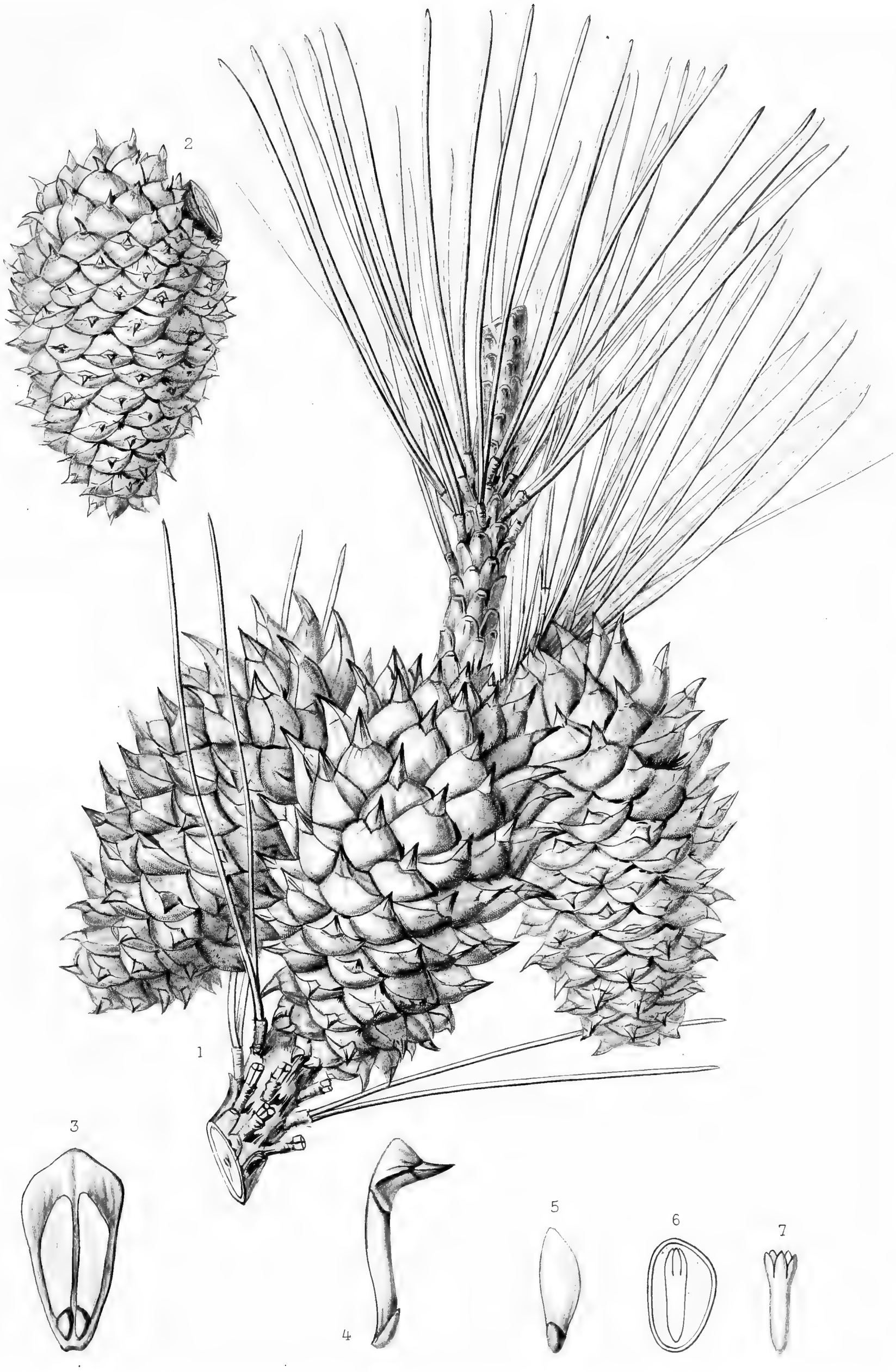
1. A fruiting branch, natural size.
2. A cone, natural size.
3. A cone-scale, upper side, with its seeds, enlarged.
4. A cone-scale, side view, enlarged.
5. A seed, natural size.
6. Vertical section of a seed, enlarged.
7. An embryo, enlarged.



C. E. Faxon del. Rapine sc.

PINUS MURICATA, D. Don.

A. Riocreux direx.t Imp J. Taneur, Paris



C.E. Faxon del. *Em. Himely sc.*

PINUS MURICATA, D. Don.

A. Riocreux direx.t *Imp. J. Taneur, Paris.*

PINUS ECHINATA.

Yellow Pine. Short-leaved Pine.

LEAVES in clusters of 2 and of 3, slender, dark blue-green, from 3 to 5 inches in length. Cones ovate or oblong-conical, from $1\frac{1}{2}$ to $2\frac{1}{2}$ inches long, their scales armed with minute slender prickles.

Pinus echinata, Miller, *Dict.* ed. 8, No. 12 (1768). — Muenchhausen, *Hausv.* v. 220. — Marshall, *Arbust. Am.* 100. — Burgsdorf, *Anleit.* pt. ii. 161. — Wangenheim, *Nordam. Holz.* 74. — Britton & Brown, *Ill. Fl.* 52, f. 116. — Mohr, *Bull.* No. 13, *Div. Forestry U. S. Dept. Agric.* 85, t. 12–16 (*The Timber Pines of the Southern U. S.*).

Pinus Virginiana, b **echinata**, Du Roi, *Obs. Bot.* 44 (1771); *Harbk. Baumz.* ii. 38.

Pinus squarrosa, Walter, *Fl. Car.* 237 (1788).

Pinus Tæda, γ **variabilis**, Aiton, *Hort. Kew.* iii. 368 (1789).

Pinus Tæda, β **echinata**, Castiglioni, *Viag. negli Stati Uniti*, ii. 312 (1790).

Pinus mitis, Michaux, *Fl. Bor.-Am.* ii. 204 (1803). — Michaux, f. *Hist. Arb. Am.* i. 52, t. 3. — Poiret, *Lamarck Dict.* Suppl. iv. 416. — Antoine, *Conif.* 16, t. 5, f. 1. — Spach, *Hist. Vég.* xi. 386. — Torrey, *Fl. N. Y.* ii. 229. — Endlicher, *Syn. Conif.* 167. — Knight, *Syn. Conif.* 26. — Lindley & Gordon, *Jour. Hort. Soc. Lond.* v. 217. — Dietrich, *Syn.* v. 399. — Carrière, *Traité Conif.* 361. — Gordon, *Pinetum*, 170; ed. 2, 243 (excl. syn. *Pinus Roylei*). — Chapman, *Fl.* 433. — Curtis, *Rep. Geolog. Surv. N. Car.* 1860, iii. 19. — Henkel & Hochstetter, *Syn. Nadelh.* 23. — Hoopes, *Evergreens*, 88. — Sénéclauze, *Conif.* 138. — Parlatore, *De Candolle Prodr.* xvi. pt. ii. 380. — K. Koch, *Dendr.* ii. pt. ii. 300. — Nördlinger, *Forstbot.* 397. — Engelmann, *Trans. St. Louis Acad.* iv. 184. — Sargent, *Forest Trees N. Am. 10th Census U. S.* ix. 200 (excl. hab. Kansas). — Lauche, *Deutsche Dendr.* ed. 2, 108. — Watson & Coulter, *Gray's Man.* ed. 6, 491. — Mayr, *Wald. Nordam.* 118, t. 8, f. — Beissner, *Handb. Nadelh.* 216. — Masters, *Jour. R. Hort. Soc.* xiv. 233. — Hansen, *Jour. R. Hort. Soc.* xiv. 374 (*Pinetum Danicum*). — Coulter, *Contrib. U. S. Nat. Herb.* ii. 554 (*Man. Pl. W. Texas*). — Koehne, *Deutsche Dendr.* 36.

Pinus variabilis, Lambert, *Pinus*, i. 22, t. 15 (1803). — Willdenow, *Spec.* iv. pt. i. 498. — Persoon, *Syn.* ii. 578. — Du Mont de Courset, *Bot. Cult.* ed. 2, vi. 460. — *Nouveau Duhamel*, v. 235, t. 69, f. 2. — Pursh, *Fl. Am. Sept.* ii. 643. — Nuttall, *Gen.* ii. 223. — Elliott, *Sk.* ii. 633. — Sprengel, *Syst.* iii. 886. — Lawson & Son, *Agric. Man.* 349; *List No. 10, Abietineæ*, 44. — Forbes, *Pinetum Woburn.* 35, t. 11. — Antoine, *Conif.* 15, t. 5, f. 2. — Link, *Linnæa*, xv. 502. — Endlicher, *Syn. Conif.* 168. — Dietrich, *Syn.* v. 399. — Courtin, *Fam. Conif.* 92.

A tree, usually from eighty to one hundred or occasionally one hundred and twenty feet in height, with a tall slightly tapering stem and a short pyramidal truncate head of comparatively slender branches which are rarely more than twenty feet in length and frequently somewhat pendulous, often producing from the stump, or from the stem and branches when injured by fire, vigorous shoots[1] usually covered with lanceolate long-pointed pale gray-green primordial leaves. The bark of the trunk is from three quarters of an inch to an inch in thickness, and is broken into large irregularly shaped plates covered with small closely appressed light cinnamon-red scales. The winter branch-buds are ovate, and gradually narrowed to the rather obtuse apex, the terminal bud, which is twice as large as the lateral buds, being about a quarter of an inch long and an eighth of an inch thick; they are covered by closely imbricated ovate-lanceolate chestnut-brown scales darker above the middle and divided into pale matted filaments, those of the inner ranks, which are fimbriated on the margins, remaining on the branches for four or five years. The branchlets, which are stout and brittle, are pale green or violet color, and covered when they first appear with a glaucous bloom; becoming dark red-brown tinged with purple before the end of the season, they then gradually grow darker, the bark beginning in the third year to separate into large scales, which when they fall disclose the light orange-brown inner bark. The leaves are borne in crowded clusters, usually of two but frequently of three, and rarely on vigorous

[1] Pinchot, *Garden and Forest*, x. 192. — Fernow, *Garden and Forest*, x. 209. — Gifford, *The Forester*, iii. 73.

young trees of four, with sheaths which at first are half an inch long, thin, silvery white, and lustrous, and before autumn are close and firm except on the scarious margins, dark gray-brown, and about a quarter of an inch in length; the leaves are closely serrulate, acute with short callous tips, soft and flexible, dark blue-green, from three to five inches long and about one sixteenth of an inch wide; they contain two fibro-vascular bundles, from three to six small resin ducts, a single layer of strengthening cells under the epidermis, and numerous bands of stomata on each face;[1] they sometimes begin to fall toward the close of their second season, and, dropping irregularly, often do not entirely disappear until their fifth year. The staminate flowers, which are produced in short crowded clusters, appear in very early spring just below the tip of the growing shoots, and are oblong-cylindrical and about three quarters of an inch in length and an eighth of an inch in thickness, with pale purple anthers terminating in orbicular obscurely denticulate crests, and are surrounded by from eight to ten involucral bracts, those of the outer rank being much smaller than the others and conspicuously keeled. The pistillate flowers, which are usually in pairs or in clusters of three or four and often appear on short lateral branchlets developed from adventitious buds on old branches,[2] are subterminal and raised on stout ascending peduncles covered by ovate-lanceolate dark chestnut-brown bracts, much spreading or reflexed in the inner ranks, and are oblong or subglobose and about one third of an inch in length, with ovate pale rose-colored scales gradually narrowed into short slender tips and large nearly orbicular bracts. Growing slowly at first, the cones during their first winter are horizontal or ascending, oblong, light chestnut-brown, and about half an inch long, with thickened scales terminating in slender rigid straight or recurved spines, and when fully grown early in the following autumn they are ovate or oblong-conical, subsessile and nearly horizontal, or short-stalked and pendent, generally clustered and usually about an inch and a half or rarely two inches and a half in length, with thin scales nearly flat below and rounded at the apex, their exposed portions, which are transversely keeled and only slightly thickened, terminating in small pale elevated oblong umbos armed with short straight or somewhat recurved and frequently deciduous prickles; the cones, which are produced in great profusion, often on trees only twelve or fifteen years old, open when ripe, turning dull brown, the bases of the scales becoming mahogany-red and lustrous on the upper and dark dull purple on the lower side, and, soon shedding their seeds, remain on the branches for several years longer. The seeds are nearly triangular, full and rounded on the sides, slightly ridged, and about three sixteenths of an inch long, with a thin pale brown hard coat conspicuously mottled with black; their wings, which are broadest near the middle, are thin, fragile, light red-brown, lustrous, half an inch long, and about an eighth of an inch wide.

Pinus echinata is distributed from Staten Island, New York,[3] and eastern Pennsylvania[4] through New Jersey and Delaware, southward through the Atlantic states to the uplands of northern Florida, crossing the Alleghany Mountains to West Virginia and to eastern Kentucky and Tennessee, and through the eastern Gulf states to the bottom-lands of the Mississippi River; west of the Mississippi River, where it is most abundant and attains its noblest size, often forming pure forests over great areas, it ranges from northeastern Texas, northwestern Louisiana, and the eastern part of the Indian Territory, through western and central Arkansas and southern Missouri to southwestern Illinois,[5] and through Kentucky and Tennessee. Although found in nearly all parts of the state of New Jersey, *Pinus echinata* is rare north of the southeastern boundary of the red sandstone except on the western

[1] Coulter & Rose, *Bot. Gazette*, xi. 308. — Bastin & Trimble, *Am. Jour. Pharm.* lxviii. 17.

[2] See Mohr, *Bull.* No. 13, *Div. Forestry U. S. Dept. Agric.* 97 (*The Timber Pines of the Southern U. S.*).

[3] According to the younger Michaux, who carefully explored the forests of eastern North America at the beginning of the present century, *Pinus echinata* in his time occurred in Massachusetts and Connecticut, and ascended the Hudson River to the neighborhood of Albany. (See *Hist. Arb.* i. 52.) If these statements are correct, it must have been exterminated in this territory, as the most eastern station in which it is now known to occur is on Staten Island, where a small grove of these trees exists.

[4] In Pennsylvania *Pinus echinata* is extremely rare, and has been reported only from Huntingdon and Lancaster Counties. (See Rothrock, *Rep. Penn. Dept. Agric.* 1895, pt. ii. *Div. Forestry*, 280.)

[5] Ridgway, *Proc. U. S. Nat. Mus.* v. 88; *Bot. Gazette*, viii. 351.

slopes of Kittatinny or Blue Mountain, but from the Raritan to the shores of Delaware Bay large forests of this Pine, frequently mixed with *Pinus rigida*, alternate with those of Oaks, Chestnuts, and other deciduous-leaved trees, often growing freely on sterile sands and clays. It is common, also, on the Delaware and Maryland peninsula; farther south it is rare in the coast region, being generally replaced by the Long-leaved Pine, and is confined chiefly to the middle and upper districts, where it is mixed with other Pines and with the prevailing Oaks and Hickories of the Appalachian forest, ascending in western North Carolina to an elevation of two thousand five hundred feet above the level of the sea. In Alabama and Mississippi the Short-leaved Pine rarely occurs in the lower part of the Pine belt of the coast; but common on the rolling hills of the central and upper regions, it here becomes a prominent feature of the forest. In western Louisiana it abounds on the uplands north of Red River, and sometimes forms pure forests or is mixed with Oaks, Hickories, and other deciduous-leaved trees, and with the Loblolly Pine; and in eastern Texas from the prairies adjacent to the valley of the Red River and above the belt of Long-leaved Pine it spreads over hundreds of square miles of low undulating hills. It inhabits dry high ridges in the Indian Territory, and in Arkansas on both sides of the Arkansas River it is frequent in the forests of deciduous-leaved trees on broken hills, and often forms great forests on wide table-lands. In Missouri, where it is generally scattered over the southern part of the state, it is most abundant on the low hills and table-lands of the southern slope of the Ozark Mountains, where its tall stems rise high above its associates, and crossing the Mississippi it maintains a foothold on river bluffs in Union and Jackson Counties, Illinois, and is distributed with widely scattered colonies through Kentucky and Tennessee.[1]

One of the most generally distributed and valuable timber-trees of eastern America, *Pinus echinata* now supplies a considerable part of the hard pine lumber cut in the trans-Mississippi pineries used in the states of the central west. The wood, which varies greatly in quality and in the thickness of the sapwood, is heavy, hard, strong, and usually coarse-grained; it is orange-color or yellow-brown, with nearly white sapwood,[2] and contains broad bands of small summer cells occupying nearly half the width of the annual growth, numerous large resin passages, and many conspicuous medullary rays. The specific gravity of the absolutely dry wood is 0.6104, a cubic foot weighing 38.04 pounds.[3] Among yellow pines it is only surpassed in quality by that of *Pinus palustris*, and being less resinous, softer, and more easily worked, it is often preferred to it for cabinet-making, for the interior finish of

[1] See Mohr, *Bull.* No. 13, *Div. Forestry U. S. Dept. Agric.* 88 (*The Timber Pines of the Southern U. S.*).

[2] The sapwood varies greatly in thickness in trees of the same diameter, the variation being apparently dependent on situation, soil, exposure, and moisture. Trees on high ridges and in dry sterile soil have usually the thinnest sapwood, although on ridges it varies from two to six inches in thickness in trees growing side by side; and on lower land from three to twelve inches. In Arkansas lumbermen recognize two varieties of the wood, yellow and bull, distinguishing them while the trees are still standing by cutting into them with axes; the bull pine, which is from low ground, grows more rapidly and is heavier with thicker sapwood, while the yellow pine, from sandy uplands, is lighter, straighter-grained, and more easily worked, and is used as a substitute for white pine in sashes, doors, blinds, and the interior finish of houses.

[3] It has been observed by Mohr (*l. c.* 98) that in Alabama the plants of this species attain a height varying from three to five feet at the end of their fifth year, the stem being from five eighths to seven eighths of an inch in thickness, and that in ten years they are from ten to sixteen feet high, with stems from two to two and a half inches in diameter. At the age of from fifteen to twenty years the trees are from twenty to thirty feet in height, with a stem diameter of four or five inches, the crown of the tree occupying from one half to five eighths of its height. At the age of fifty years the height of the trees varies from forty to sixty feet, and the trunk diameter from ten to fourteen inches. Between sixty and seventy years of age the trees are from fifty to seventy feet high, with a trunk diameter of from twelve to fifteen inches, and in their one hundredth year average from ninety to ninety-five feet in height, with a trunk diameter of from sixteen to nineteen inches. Between the ages of one hundred and twenty and one hundred and thirty years trees from ninety to one hundred and ten feet occur, with trunks from eighteen to twenty-four inches in diameter. The oldest tree examined by Mohr had two hundred and eight layers of annual growth, and was one hundred and nine feet in height, with a trunk twenty-four inches in diameter. The largest tree felled by him was one hundred and seventeen feet high, with a trunk diameter of twenty-five inches and one hundred and forty-three layers of annual growth.

The log specimen, cut in Arkansas, in the Jesup Collection of North American Woods in the American Museum of Natural History, New York, is twenty-three and a half inches in diameter inside the bark, and two hundred and seven years of age. In this specimen the sapwood is two inches and a half thick and seventy-four years old.

houses, and in the manufacture of sashes, doors, and blinds. It is largely used for these purposes, for the framework of buildings, weather-boards, and for flooring and shingles, in car-building, and for railway ties. It contains a large quantity of resin, and in North Carolina young trees, which are the most prolific, are worked for the production of turpentine.[1]

Pinus echinata,[2] which was cultivated in England before the middle of the eighteenth century,[3] was first described by Plukenet in 1696;[4] it is occasionally cultivated as an ornamental tree, and has proved hardy as far north as eastern Massachusetts. Spreading now rapidly over abandoned fields in the upper districts of the south Atlantic and Gulf states, which it soon covers with healthy forests, the Short-leaved Pine seems destined to play an important part in restoring fertility to their lands and in supplying new crops of valuable timber.

[1] Ashe, *Bull.* No. 5, *North Carolina Geolog. Surv.* 88 (*The Forest, Forest Lands, and Forest Products of Eastern North Carolina*).

[2] *Pinus echinata* is also known as Spruce Pine in Delaware, Mississippi, and Arkansas; as Pitch Pine in Missouri, where it is the only Pine-tree; and as Bull Pine in Virginia.

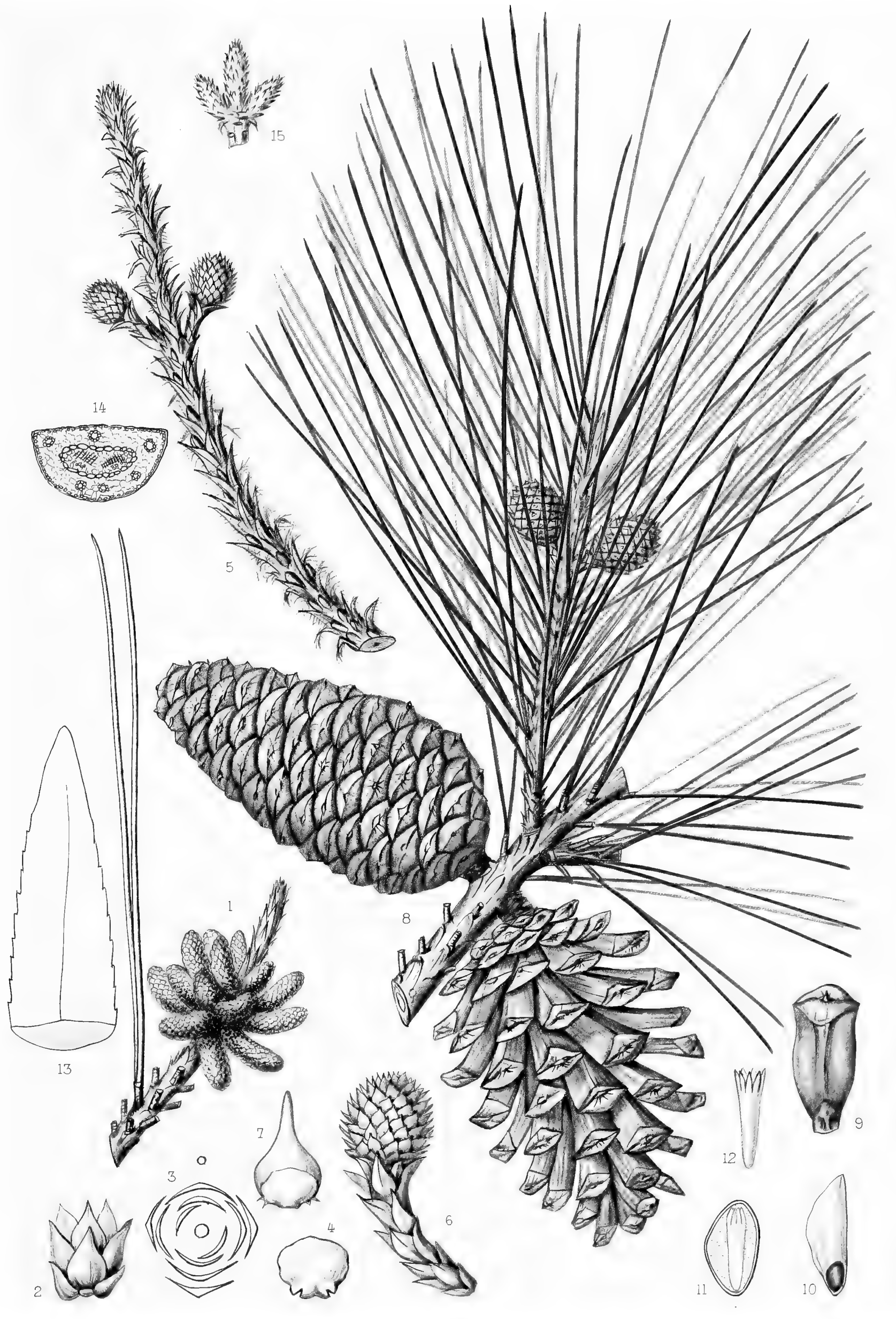
[3] Aiton, *Hort. Kew.* ed. 2, v. 316 (as *Pinus variabilis*). — Loudon, *Arb. Brit.* iv. 2195, f. 2072–2076 (as *Pinus mitis*).

[4] *Pinus Virginiana prælongis foliis tenuioribus cono echinato gracili, Alm. Bot.* 297. — Duhamel, *Traité des Arbres*, ii. 126.

EXPLANATION OF THE PLATE.

PLATE DLXXXVII. PINUS ECHINATA.

1. An end of a branch with staminate flowers, natural size.
2. An involucre of a staminate flower, enlarged.
3. Diagram of the involucre of the staminate flower.
4. An anther, front view, enlarged.
5. An end of a branch with pistillate flowers, natural size.
6. A pistillate flower, enlarged.
7. A scale of a pistillate flower, lower side, with its bract, enlarged.
8. A fruiting branch, natural size.
9. A cone-scale, lower side, with its bract, natural size.
10. A seed, natural size.
11. Vertical section of a seed, enlarged.
12. An embryo, enlarged.
13. Tip of a leaf, enlarged.
14. Cross section of a leaf, magnified fifteen diameters.



C.E Faxon del. Em. Himely sc

PINUS ECHINATA, Mill.

A. Riocreux direx.t Imp. J. Taneur, Paris

PINUS DIVARICATA.

Gray Pine. Jack Pine.

LEAVES in clusters of 2, stout, falcate, divergent, dark gray-green, from $\frac{3}{4}$ of an inch to $1\frac{1}{4}$ inches in length. Cones oblong-conical, oblique, usually erect, incurved, from $1\frac{1}{2}$ to 2 inches long, their scales furnished with minute incurved often deciduous prickles.

Pinus divaricata, Du Mont de Courset, *Bot. Cult.* iii. 760 (1802). — Sudworth, *Bull. Torrey Bot. Club*, xx. 44; *Rep. U. S. Dept. Agric.* 1892, 329.

Pinus sylvestris, δ **divaricata**, Aiton, *Hort. Kew.* iii. 366 (1789).

Pinus Banksiana, Lambert, *Pinus*, i. 7, t. 3 (1803). — Persoon, *Syn.* ii. 578. — Desfontaines, *Hist. Arb.* ii. 611. — *Nouveau Duhamel*, v. 234, t. 67, f. 3. — Aiton, *Hort. Kew.* ed. 2, v. 315. — Pursh, *Fl. Am. Sept.* ii. 642. — Nuttall, *Gen.* ii. 223. — Sprengel, *Syst.* iii. 886. — Lawson & Son, *Agric. Man.* 345; *List No. 10, Abietineæ*, 35. — Forbes, *Pinetum Woburn.* 13, t. 3. — Hooker, *Fl. Bor.-Am.* ii. 161. — Antoine, *Conif.* 8, t. 4, f. 2. — Link, *Linnæa*, xv. 491. — Spach, *Hist. Vég.* xi. 379. — Endlicher, *Syn. Conif.* 177. — Knight, *Syn. Conif.* 26. — Lindley & Gordon, *Jour. Hort. Soc. Lond.* v. 218 (excl. syn. *Pinus contorta*). — Dietrich, *Syn.* v. 400. — Carrière, *Traité Conif.* 381. — Gordon, *Pinetum*, 163. — Courtin, *Fam. Conif.* 81. — Henkel & Hochstetter, *Syn. Nadelh.* 44. — (Nelson) Senilis, *Pinaceæ*, 104. — Hoopes, *Evergreens*, 78. — Sénéclauze, *Conif.* 132. — Engelmann, *Trans. St. Louis Acad.* iv. 184. — Veitch, *Man. Conif.* 158. — Regel, *Russ. Dendr.* pt. i. ed. 2, 46. — Schübeler, *Virid. Norveg.* i. 392. — Willkomm, *Forst. Fl.* 242. — Sargent, *Forest Trees N. Am.* 10*th Census U. S.* ix. 201. — Watson & Coulter, *Gray's Man.* ed. 6, 491. — Mayr, *Wald. Nordam.* 214, t. 8, f. — Beissner, *Handb. Nadelh.* 218. — Masters, *Jour. R. Hort. Soc.* xiv. 226. — Hansen, *Jour. R. Hort. Soc.* xiv. 350 (*Pinetum Danicum*). — Koehne, *Deutsche Dendr.* 36.

Pinus Hudsonia, Poiret, *Lamarck Dict.* v. 339 (1804).

Pinus rupestris, Michaux f. *Hist. Arb. Am.* i. 49, t. 2 (1810). — Provancher, *Fl. Canadienne*, ii. 555.

Pinus Hudsonica, Parlatore, *De Candolle Prodr.* xvi. pt. ii. 380 (1868). — K. Koch, *Dendr.* ii. pt. ii. 298. — Lauche, *Deutsche Dendr.* ed. 2, 108 (1883).

A tree, frequently seventy feet in height, with a straight trunk sometimes free of branches for twenty or thirty feet, and rarely exceeding two feet in diameter,[1] and long spreading flexible branches forming an open symmetrical head; often not more than twenty or thirty feet tall, with a stem ten or twelve inches in diameter, generally fruiting when only a few years old, and sometimes shrubby, with stems not more than two or three feet high. The bark of the trunk is thin, dark brown slightly tinged with red, and very irregularly divided into narrow rounded connected ridges separating on the surface into small thick closely appressed scales. The winter branch-buds are ovate and usually abruptly narrowed at the full and rounded apex, the terminal bud being about a quarter of an inch long and an eighth of an inch thick and nearly twice as long as the lateral buds; they are covered by ovate lanceolate pale chestnut-brown scales with spreading tips; soon becoming reflexed on the lengthening shoots, from which they fall before midsummer, leaving their dark thickened bases to roughen the branches for ten or twelve years. The branchlets are slender, tough and flexible, and pale yellow-green and glabrous in their first season, turning dark purple tinged with red during their first winter and becoming dark purple-brown the following year. The leaves are borne in rather remote clusters of two, with loose sheaths which at first are scarious, pale chestnut-brown below, silvery white above, and nearly an eighth of an inch long, and in their second year are black and often not more than one twenty-fourth of an inch in length; the leaves are finely serrulate, abruptly narrowed at the apex, which terminates in a short callous point, somewhat falcate, rounded on the back, nearly flat or slightly concave on the inner face, spreading from the base, at first light yellow-green but dark green at the end of their first season, usually about an inch but varying from three quarters of an inch to an inch and a quarter in length, from one twentieth to one sixteenth of an inch wide, and persistent

[1] Britton, *Bull. Torrey Bot. Club*, x. 82. — Merriam, *Gard. Chron.* n. ser. xx. 503.

until the second or third year, when they fall gradually and irregularly; they contain two fibro-vascular bundles, one or two parenchymatous resin ducts, which are sometimes wanting, and strengthening cells under the epidermis between the numerous bands of deep-set stomata.[1] The staminate flowers are produced in crowded clusters usually about an inch and a half in length, and are oblong and from one third to one half of an inch long and about one eighth of an inch thick, with yellow anthers terminating in nearly orbicular obscurely denticulate crests, and are surrounded by from six to eight involucral bracts. The pistillate flowers, which are subglobose, with dark purple ovate scales gradually narrowed into short incurved tips, are produced in clusters of from two to four on the terminal shoot and on its numerous lateral branchlets, two clusters being often produced on the same leading shoot, and are raised on stout peduncles from one eighth to nearly one quarter of an inch long, and covered by large chestnut-brown broadly ovate acute bracts which immediately under the flower are scarious and spreading or reflexed. The cones during their first winter are erect, subglobose or oblong, and about a quarter of an inch in length, light yellow-brown, and armed with minute incurved prickles; and when they are fully grown in the following autumn they are oblong-conical, acute, oblique at the base, sessile, erect and strongly incurved, or slightly spreading and occasionally recurved above the middle, from an inch and a half to two inches long, from one half to three quarters of an inch thick, dull purple or green when fully grown, and pale yellow-brown and lustrous at maturity, with thin stiff scales rounded at the apex, and below dark dull purple on the lower and bright mahogany-red and lustrous on the upper side, their exposed portions, which terminate in minute circular oblong concave dark umbos, furnished with minute incurved often deciduous prickles, being on the outside of the cone and especially near the base much thickened into large mammillate knobs, and on the inside smaller and mammillate near the base of the cone and above transversely keeled, slightly thickened, or nearly flat; they usually remain closed for several years, opening very irregularly, and generally not falling for twelve or fifteen years. The seeds are nearly triangular, full and rounded on the sides, and about three eighths of an inch long, with almost black tuberculate coats and an embryo with four or five cotyledons; their wings are pale, lustrous, broadest at the middle, full and rounded at the apex, one third of an inch long and one eighth of an inch wide.

Pinus divaricata is distributed from the neighborhood of Halifax, Nova Scotia, to the shores of the Bay of Chaleurs and to those of Lake Mistassinnie, and westward south of a line about one hundred miles south of James Bay to the valley of Moose River, and then northwestward to the neighborhood of Fort Assiniboine on the Athabasca River and down the valley of the Mackenzie River, where it is the only Pine-tree, to about latitude 65° north;[2] southward it ranges to the shores of Schoodic peninsula in Frenchman's Bay[3] and Alamoosook Lake,[4] Maine, Welch Mt., New Hampshire,[5] to western Vermont[6] and the Adirondacks,[7] to the southern shores of Lake Michigan in Indiana and Illinois, the banks of the Lacrosse and Black Rivers in northern Illinois,[8] and to central Minnesota. In eastern Canada, where at the north it is often a mere shrub, and on the borders of the northeastern states, it usually grows in small widely scattered colonies. It is more abundant in central Michigan, covering great tracts of barren lands,[9] and on the sand dunes along the southern shores of Lake Michigan, where it mingles with *Pinus Strobus* and with stunted Oaks and other deciduous-leaved

[1] Coulter & Rose, *Bot. Gazette*, xi. 308.

[2] Brunet, *Cat. Vég. Lig. Can.* 56. — Bell, *Bull. Geolog. Rep. Can.* 1879–80, 46°. — Macoun, *Cat. Can. Pl.* 468.

[3] Redfield & Rand, *Bot. Gazette*, xvi. 294; *Fl. Mt. Desert Island*, 149. — Rand, *Garden and Forest*, ii. 579.

[4] *Pinus divaricata* was found several years ago at the outlet of Alamoosook Lake, Orland, Hancock County, Maine, by Mr. George H. Witherle of Castine, Maine. One tree at this place was about fifty feet high.

[5] *Appalachia*, iii. 65. — *Bull. Torrey Bot. Club*, xviii. 150.

[6] About 1860 a small grove of *Pinus divaricata* was found near Ferrisburg in Addison County, western Vermont, by Mr. Rowland E. Robinson of Ferrisburg.

[7] J. H. Sears, *Bull. Essex Inst.* xiii. 186.

[8] Pammel, *Garden and Forest*, iv. 532.

[9] In the upper part of the lower peninsula of Michigan numerous barrens, the largest with an area of several hundred square miles, are covered with this tree and are known as Jack Pine Plains from one of its common names. (See *Garden and Forest*, i. 398.)

In northern Michigan, Wisconsin, and Minnesota, *Pinus divaricata* forms a valuable nurse for seedling plants of *Pinus resinosa* on

trees; north of Lake Superior it often grows to a large size and is common, but probably is most abundant, and attains its greatest size and beauty in the region west of Lake Winnipeg and north of the Saskatchewan, where it frequently stretches over great areas of sandy sterile soil, abounding in the valley of the Mackenzie as *Pinus contorta* does on the western slope of the Rocky Mountains in the same latitude.[1]

The wood of *Pinus divaricata* is light, soft, not strong and close-grained; it is clear pale brown or rarely orange-color, with thick nearly white sapwood, and contains broad conspicuous resinous bands of small summer cells, few small resin passages, and numerous obscure medullary rays. The specific gravity of the absolutely dry wood is 0.4761, a cubic foot weighing 29.67 pounds. It is cut for fuel in the Province of Quebec, and sometimes is used for railway ties and posts; occasionally it is manufactured into lumber. By the Indians of Canada it was valued for the frames of canoes.[2]

Pinus divaricata was probably cultivated in England before the middle of the eighteenth century.[3] Its short spreading leaves and open habit do not, however, greatly commend it to the planters of ornamental trees, and a colder climate than that of any part of the United States south of its northern border is needed to develop its beauty and insure its long life.[4]

land from which the forest has been cut, until they are overtopped by them at the end of a few years, and then as undergrowth serve to prevent the development of limbs on the trunks of the more valuable species; and it is not improbable that large areas in these states would now be practically deserts but for the existence of this hardy and fast-growing tree. (See Ayres, *Garden and Forest*, ii. 261. — See, also, Douglas, *Garden and Forest*, ii. 285.)

[1] G. M. Dawson, *Garden and Forest*, i. 59.

[2] Richardson, *Franklin Jour.* Appx. No. 7, 752.

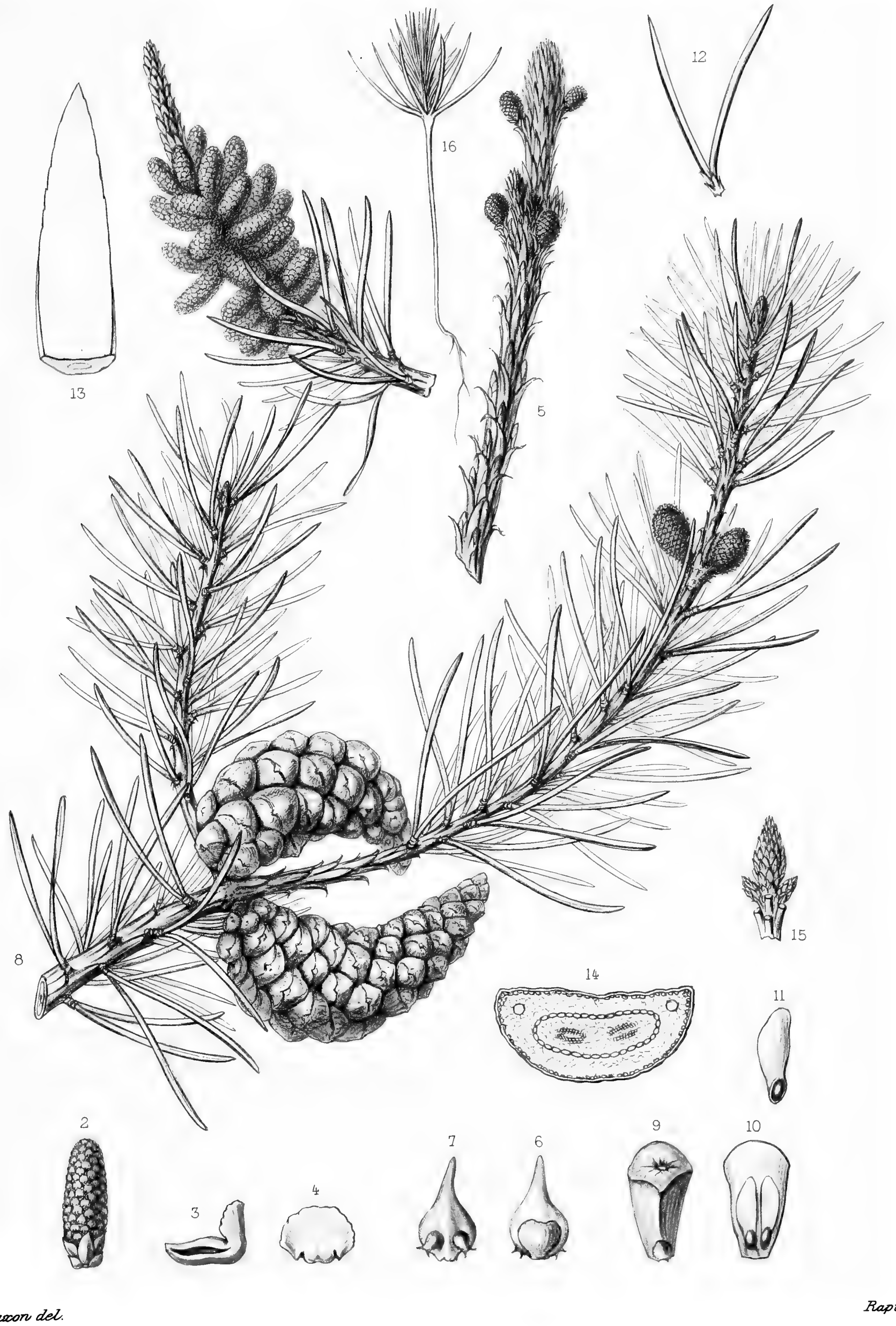
[3] Loudon, *Arb. Brit.* iv. 2190, f. 2064–2067.

[4] Curious fancies concerning this tree have taken possession of the popular mind in some parts of the country. It is considered dangerous to those who pass within ten feet of its limbs, the danger being greater for women than for men; it is believed to poison the soil in which it grows and to be fatal to cattle browsing near it; and if any misfortune comes to a man who has one of these trees on his land, or to his cattle, it must be burned down with wood, which is piled around it, for the prejudice against it is so strong that no one possessed of this belief would venture to cut down a Gray Pine.

EXPLANATION OF THE PLATE.

Plate DLXXXVIII. Pinus divaricata.

1. A branch with staminate flowers, natural size.
2. A staminate flower, enlarged.
3. An anther, side view, enlarged.
4. An anther, front view, enlarged.
5. A branch with pistillate flowers, natural size.
6. A scale of a pistillate flower, lower side, with its bract, enlarged.
7. A scale of a pistillate flower, upper side, with its ovules, enlarged.
8. A fruiting branch, natural size.
9. A cone-scale, lower side, natural size.
10. A cone-scale, upper side, natural size.
11. A seed, natural size.
12. A cluster of young leaves, natural size.
13. Tip of a leaf, enlarged.
14. Cross section of a leaf, magnified fifteen diameters.
15. A winter branch-bud, enlarged.
16. A seedling plant, natural size.



C.E. Faxon del. Rapine sc.

PINUS DIVARICATA, Du Mont.

A. Riocreux direx.t Imp. J. Taneur, Paris.

PINUS PALUSTRIS.

Long-leaved Pine. Southern Pine.

LEAVES in clusters of 3, slender, flexible, dark green, from 8 to 18 inches in length. Cones cylindrical or conical, oblong, from 6 to 10 inches long, their scales armed with short recurved spines.

Pinus palustris, Miller, *Dict.* ed. 8, No. 14 (1768). — Muenchhausen, *Hausv.* v. 220. — Du Roi, *Harbk. Baumz.* ii. 49. — Burgsdorf, *Anleit.* pt. ii. 163. — Wangenheim, *Nordam. Holz.* 73. — Walter, *Fl. Car.* 237. — Aiton, *Hort. Kew.* iii. 368. — Abbot & Smith, *Insects of Georgia*, i. 83, t. 42. — Willdenow, *Berl. Baumz.* 211; *Spec.* iv. pt. i. 499. — Borkhausen, *Handb. Forstbot.* 434. — Michaux, *Fl. Bor.-Am.* ii. 204. — Lambert, *Pinus*, i. 27, t. 20. — Poiret, *Lamarck Dict.* v. 341. — Persoon, *Syn.* ii. 578. — Du Mont de Courset, *Bot. Cult.* ed. 2, vi. 461. — Desfontaines, *Hist. Arb.* ii. 612. — Pursh, *Fl. Am. Sept.* ii. 644. — Nuttall, *Gen.* ii. 223. — Hayne, *Dendr. Fl.* 174. — Elliott, *Sk.* ii. 637. — Sprengel, *Syst.* iii. 887. — Forbes, *Pinetum Woburn.* 59, t. 22. — Link, *Handb.* ii. 477; *Linnæa*, xv. 506. — Griffith, *Med. Bot.* 604. — Sargent, *Forest Trees N. Am.* 10*th Census U. S.* ix. 201. — Watson & Coulter, *Gray's Man.* ed. 6, 491. — Masters, *Jour. R. Hort. Soc.* xiv. 236. — Coulter, *Contrib. U. S. Nat. Herb.* ii. 554 (*Man. Pl. W. Texas*). — Britton & Brown, *Ill. Fl.* i. 51, f. 112. — Mohr, *Bull.* No. 13, *Div. Forestry U. S. Dept. Agric.* 26, t. 2–7 (*The Timber Pines of the Southern U. S.*).

Pinus lutea, Walter, *Fl. Car.* 237 (1788).

Pinus Tæda, δ palustris, Castiglioni, *Viag. negli Stati Uniti*, ii. 313 (1790).

Pinus longifolia, Salisbury, *Prodr.* 398 (1796).

Pinus australis, Michaux f. *Hist. Arb. Am.* i. 64, t. 6 (1810). — *Nouveau Duhamel*, v. 246, t. 75, f. 3. — Lawson & Son, *Agric. Man.* 350; *List No. 10, Abietineæ*, 30. — Loudon, *Arb. Brit.* iv. 2255, f. 2156–2160. — Antoine, *Conif.* 23, t. 6, f. 2. — Spach, *Hist. Vég.* xi. 392. — Endlicher, *Syn. Conif.* 165. — Carson, *Med. Bot.* ii. 43, t. 87. — Gihoul, *Arb. Rés.* 33. — Knight, *Syn. Conif.* 30. — Lindley & Gordon, *Jour. Hort. Soc. Lond.* v. 217. — Dietrich, *Syn.* v. 399. — Carrière, *Traité Conif.* 345. — Gordon, *Pinetum*, 187. — Courtin, *Fam. Conif.* 76. — Chapman, *Fl.* 434. — Curtis, *Rep. Geolog. Surv. N. Car.* 1860, iii. 24. — Henkel & Hochstetter, *Syn. Nadelh.* 65. — (Nelson) Senilis, *Pinaceæ*, 103. — Hoopes, *Evergreens*, 109. — Parlatore, *De Candolle Prodr.* xvi. pt. ii. 392. — Nördlinger, *Forstbot.* 401. — Bentley & Trimen, *Med. Pl.* iv. 258, t. 258. — Engelmann, *Trans. St. Louis Acad.* iv. 185. — Veitch, *Man. Conif.* 172. — Mayr, *Wald. Nordam.* 109, t. 7, f. — Hansen, *Jour. R. Hort. Soc.* xiv. 346 (*Pinetum Danicum*).

? **Pinus australis excelsa**, Loudon, *Arb. Brit.* iv. 2256 (1838). — Forbes, *Pinetum Woburn.* 62. — Courtin, *Fam. Conif.* 76.

A tree, growing to an average height of about one hundred feet and to a maximum height of one hundred and twenty, with a tall straight slightly tapering trunk usually from two to two and a half feet but occasionally three feet in diameter, a massive tap-root penetrating deep into the ground, thick lateral roots spreading widely near the surface or descending deeply, and stout slightly branched gnarled and twisted limbs covered with thin dark scaly bark, and forming an open elongated and usually very irregular head from one third to one half the length of the tree. The bark of the trunk varies from one sixteenth to one half of an inch in thickness, and is light orange-brown and separated on the surface into large closely appressed papery scales, or when much thickened broken by shallow longitudinal and cross fissures into oblong scaly plates. The winter branch-buds gradually widen from the base to above the middle and then narrow to the acute apex, the terminal bud, which is often twice as large as the lateral buds, being from two to two and a half inches long and half an inch thick; they are covered by elongated linear-lanceolate silvery white lustrous scales divided on the margins, except near the apex, into long spreading filaments which form a cobweb-like network over the bud through which spread the slightly reflexed tips of the scales; the inner scales, which at first densely cover the lengthening shoots, become much reflexed and, slowly changing to a dull orange-color, usually remain at the base of the leaf-clusters until these fall, leaving their much thickened bases to roughen the

branches for several years longer. The leaves are borne in crowded clusters of three, forming dense tufts at the very ends of the branches; their sheaths, which consist of eight pairs of bud-scales, are thin during their first year, pale orange-color, and loose and scarious on the free margins, and later become dark brown, falling with the leaves at the end of the second year; the leaves are serrulate, acute with short callous tips, soft and flexible, pendulous and dark green; on old trees they are usually about eight inches, but on young and vigorous trees generally from twelve to eighteen inches in length, and are about one sixteenth of an inch in width; they contain two fibro-vascular bundles, usually from three to five, generally internal resin ducts occasionally surrounded with strengthening cells which, however, mostly occur on the ventral side of the fibro-vascular region, and many bands of deep-set stomata on their three faces.[1] The flowers are produced in very early spring before the appearance of the new leaves, the staminate in short dense clusters from the axils of the lowest scales of the branch-bud before it has begun to lengthen, the pistillate subterminal just below the apex of the lengthening shoot and usually in pairs or in clusters of three or four, the staminate and pistillate flowers being occasionally produced on the same branch. The staminate flowers are cylindrical, incurved, from two to two and a half inches in length and about a quarter of an inch in thickness, with dark rose-purple anthers terminating in almost orbicular denticulate crests, and are surrounded by involucres of from ten to twelve bracts; withering, they remain for several months on the branches. The pistillate flowers are raised on short stout peduncles covered by numerous membranaceous bracts scarious, spreading, and often reflexed at the apex, and are oval and about a third of an inch in length, with broadly ovate dark purple scales gradually narrowed into slender tips, and nearly orbicular bracts as large as the base of the scales. As soon as their ovules are fertilized the young cones grow rapidly for a few weeks, becoming about two thirds of an inch in length, and then increase very slowly, remaining erect during the winter, when they are not more than an inch in length, and dark red-brown; beginning to grow again in early spring, they soon become horizontal; and when they have attained their full size in the autumn they are cylindrical or conical-oblong, slightly curved, nearly sessile, horizontal or pendent, dark green, with chestnut-brown umbos and prickles, from six to ten inches long and about two inches thick, with thin flat scales rounded at the apex, their exposed portions, which are conspicuously transversely keeled and somewhat thickened, terminating in elevated transversely compressed slightly incurved dark umbos armed with small reflexed prickles; turning dull brown when fully ripe, the base of the scales being now dark rich purple on the lower side and reddish brown and lustrous on the upper, they open and shed their seeds late in the autumn, and remaining on the branches until the latter part of the following winter, leave in falling a few of their basal scales attached to the stem. The seeds are almost triangular, full and rounded on the sides, prominently ridged and about half an inch long, with a thin pale coat marked with dark blotches on the upper side and a sweet slightly resinous embryo with from seven to ten cotyledons; their wings are thin, fragile, pale reddish brown and lustrous, widest near the middle, gradually narrowed to the very oblique apex, about an inch and three quarters long and seven sixteenths of an inch wide.

Pinus palustris, which is chiefly confined to a belt of late tertiary sands and gravels stretching along the coast of the south Atlantic and Gulf states and rarely more than one hundred and twenty-five miles in width, is distributed from the extreme southeastern part of Virginia[2] southward to Cape Canaveral and the shores of Tampa Bay, Florida, and westward to the uplands east of the bottoms of the Mississippi River,[3] in Alabama extending northward to latitude 34° 30′ north and ascending the

[1] Coulter & Rose, *Bot. Gazette*, xi. 309. — Bastin & Trimble, *Am. Jour. Pharm.* lxviii. 74, f. 14.

[2] *Pinus palustris* extends only a few miles north of the southern boundary of Virginia into the southeastern counties. (See Ruffin, *Russell's Magazine*, iv. 35.)

[3] Dr. Charles Mohr, who has carefully studied the distribution of *Pinus palustris*, separates the great maritime Pine belt east of the Mississippi River into three divisions, based on their topographical features and on the mechanical and physical conditions of their soils.

(1.) The coast plain, an imperfectly drained tidal region of low Pine barrens, extending inland from ten to thirty miles and covered with open forests of the Long-leaved Pine, interrupted by inlets from the sea, brackish marshes, and numerous swamps bear-

southern foothills of the Appalachian Mountains to an altitude of two thousand feet above the level of the sea;[1] west of the Mississippi River it ranges to the valley of the Trinity River, and from the neighborhood of the coast to the thirty-second degree of north latitude in Texas, and in western Louisiana nearly to the northern borders of the state.[2]

The most valuable of the Pitch Pines and one of the most important timber-trees of North America, *Pinus palustris* produces heavy, exceedingly hard very strong tough coarse-grained durable wood; it is light red or orange-color, with thin nearly white sapwood, and contains broad bands of small resinous summer cells occupying about half the width of the annual growth, few inconspicuous resin passages, and many conspicuous medullary rays. The specific gravity of the absolutely dry wood is 0.6999, a cubic foot weighing 43.62 pounds.[3] It is largely used for masts and spars, and in the

ing White Cedars, Bays, Water Oaks, Live Oaks, Magnolias, and Gum-trees. On slightly higher and better drained levels the Long-leaved Pine was once more abundant, but it has now almost entirely disappeared from all parts of the coast plain and has been replaced by *Pinus Tœda* and *Pinus heterophylla*.

(2.) The rolling Pine hills or upland Pine barrens rising in the Atlantic states some six hundred feet above the sea-level, and spreading in the Gulf states into broad undulating lower table-lands. These hills and table-lands were once covered exclusively by forests of the Long-leaved Pine, extending without interruption over hundreds of square miles in gloomy monotony.

(3.) The upper division or region of mixed growth. In this interior region, where the Long-leaved Pine grows to its largest dimensions with the largest proportion of trees of maximum size, it is confined to ridges covered by drifted sands and pebbles, to rocky heights, alternating with open Oak woods growing on calcareous loams and marls, and to areas on which the drifts have mixed with these loams and marls, where it mingles with deciduous-leaved trees and with the Loblolly and Short-leaved Pines. (See Mohr, *Bull.* No. 13, *Div. Forestry U. S. Dept. Agric.* 30 [*The Timber Pines of the Southern U. S.*].)

[1] On Blue Mountain or Talladega Mountain Range in Talladega County, Alabama, *Pinus palustris* flourishes up to an elevation of two thousand feet above the sea, although in this part of the state it usually disappears at from three to five hundred feet lower (Mohr, *l. c.* 73).

[2] West of the Mississippi River the forests of *Pinus palustris* are also confined to the sands and gravels of the latest tertiary formations, occupying in Louisiana two distinct regions; in one, south of Red River, it extends from the borders of the treeless savannas of the coast to the bottoms of Red River, and from the eastern boundary of Calcasieu Parish to the Sabine River, which it crosses into Texas; in the other, north of Red River, it extends nearly to Arkansas, and from the uplands bordering the bottoms of the Ouachita westward along the shores of Lake Catahoula until it is stopped again by the alluvial deposits of Red River. The Pine flats near the Louisiana coast, which are imperfectly drained and often covered with water, produce an open forest of comparatively small trees, which have already been cut and, owing to the unfavorable nature of the soil, are not replacing themselves. Farther from the coast in all the region south of Red River, on low ridges the Long-leaved Pine, crowded in dense forests, grows to a great height and produces timber of excellent quality. The undulating uplands immediately north of the Red River bottoms are still covered with pure nearly unbroken forests of this tree; farther north Pine-covered ridges rise between flats clothed with White Oaks and Hickories, and still farther north the forests are more open and the Long-leaved Pines, which grow here in great perfection, are mixed with the Short-leaved Pine and with deciduous-leaved trees.

In Texas, as in Louisiana, the imperfectly drained coast flats have been stripped of their Pine forests, but farther inland, on gentle undulating low hills, this tree grows rapidly to a large size, producing timber equaling that produced in the adjacent pineries of southwestern Louisiana. (See Mohr, *l. c.* 44.)

[3] During their early years the seedlings of *Pinus palustris* devote most of their energies to the development of the powerful root system peculiar to this tree, the stem at the end of the first year being rarely over three quarters of an inch in length, although the tap-root at this time is often from eight to ten inches long. At the end of another year the tap-root is often from two to three feet long, while the stem is scarcely an inch and a half high; and at the end of the fourth year the average plant is not more than five inches in height, while the tap-root has constantly gained in thickness and length. In its seventh year the plant enters a period of vigorous growth, the stem increasing rapidly in length and producing branches in regular whorls, its upward growth during several seasons varying at this period from ten to twenty inches. Trees grown on abandoned farms, and from thirty to thirty-five years of age, have a height of from forty-five to fifty feet and a trunk diameter of ten and a half or eleven inches, their leading shoots being sometimes two feet in length, while trees of the same age grown in the forest on land which has never been cleared require almost twice as long to attain the same size. When twenty years of age the trees begin to produce flowers and fruit, and during the following ten or fifteen years attain an average height of from forty to forty-five feet, with clear stems free of branches for a considerable distance above the ground. Growing upward rapidly with an average yearly increase of fourteen or fifteen inches during its first half century, the average upward growth during the next fifty years is not more than four or five inches, and between the ages of one hundred and two hundred and fifty years the usual increase is only about an inch and a half, the decrease in the accretion of wood corresponding with the production of the upward growth of the stem and branches. After they have reached the age of two hundred years the trees generally become wind-shaken and defective, while the exhaustion of the soil lessens their vitality and increases their danger from disease and the attacks of insects, and trees over two hundred and seventy-five years old are exceptional. (See Mohr, *l. c.* 55, for an elaborate account of the rate of growth of *Pinus palustris* in different parts of the country, and for a discussion of the conditions essential to its best development. See, also, Mlodziansky, *Garden and Forest*, ix. 72.)

The log specimen in the Jesup Collection of North American Woods in the American Museum of Natural History, New York, cut in southern Georgia, is seventeen inches and three quarters in

building of bridges, viaducts, and trestle-work, in the construction of railway cars, for which it is preferred in the United States to any other wood, for railway ties,[1] fencing, flooring, and the interior finish of buildings, and for fuel[2] and charcoal.

Rich in resinous secretions, *Pinus palustris* supplies the world with a large part of its naval stores.[3]

diameter inside the bark, and two hundred and twenty years old. The sapwood of this specimen is an inch in thickness, with forty layers of annual growth, and the bark is only an eighth of an inch thick.

[1] Railway ties of hard pine are every year in greater demand; they are used almost exclusively in the south, and are now laid on many of the principal lines in the northern states, which a few years ago depended on local supplies of white oak and chestnut. This makes constant and increasing drafts upon the forests of Long-leaved Pine, enormous quantities of young trees being cut every year for ties. The trees used are generally fifteen or sixteen inches in diameter at three feet above the ground, and, as rule, only the butt cuts are used, usually not more than ten ties being obtained from an acre. The best trees are therefore sacrificed long before they reach the period of greatest value.

[2] Of late years a profitable industry has been developed in the south by cutting the resinous stumps of trees in abandoned turpentine orchards into long narrow strips about three quarters of an inch thick, steaming them, and rolling them into small bundles, which are shipped to the north, and sold for kindling wood. Pine wood, called light wood, abnormally filled with resin, the result of working the tree for turpentine, is very durable in contact with the soil, and is often used in the southern states for fence-posts.

[3] The production of turpentine in the pineries adjacent to the coast of North Carolina had become an industry of considerable importance before the Revolution, most of the crude turpentine being sent to England. After the war it was distilled in clumsy iron retorts in North Carolina and in some of the northern cities, and as early as 1818 the demand had greatly increased the supply, although the field of operation was not extended south of Cape Fear River nor more than a hundred miles from the coast until 1836; but the introduction of the copper still in 1834 and the demand for spirits of turpentine in the manufacture of india rubber goods and for illuminating purposes, rapidly developed this industry, which gradually spread farther inland and began to move southward, although Wilmington, North Carolina, remained the chief centre for the distribution of naval stores until a few years ago, when ports nearer to the productive forests superseded it. The manufacture of naval stores under the influence of ruinous competition has often exceeded the demand, and as thus only the most wasteful methods, having in view large and immediate returns without regard for future supplies, have been profitable, widespread ruin has been caused in the southern pineries. Searching always for virgin forests, the industry has gradually spread until it has now invaded every state where *Pinus palustris* grows. Although it is not probable that the drawing off of the resinous juices of the trees has an injurious effect upon the heartwood, the formation of the resin taking place only in the sapwood, the timber of boxed trees is almost invariably ruined, as if left standing they are attacked by fire, which so weakens them that they are soon blown over, or are destroyed by the boring of capricorn beetles or by the spread of fungal diseases over the wounds on the trunk.

The trees selected for boxing are usually from twelve to eighteen inches in diameter, although trunks only eight inches through are now sometimes worked. A deep notch or box is made in the trunk of the tree by a cut generally made at twelve inches above the ground, slanting downward about seven inches in depth, and joined by a second cut started ten inches above the first, and extending down from the bark to meet it. In this way a segment is removed from the trunk, and a triangular trough formed four inches deep and four inches wide at the top, with a capacity of about three pints. Two such boxes, or upon a large trunk sometimes four, are made on each tree. A crop, the unit of production, consists of ten thousand boxes. They are cut early in November with a narrow-bladed axe specially manufactured for the purpose, and the trees are worked on an average during thirty-two weeks. As soon as the upper surface of the box ceases to exude freely, it is hacked over and a fresh surface exposed, the dried resin adhering to the wound having been first carefully removed with a sharp narrow steel scraper, the hacking being done with a strong dull knife fastened to the end of a short handle which is furnished at the lower end with an iron ball weighing about four pounds to give increased force to the strokes and thus lighten the labor. The boxes, especially after the first season, are frequently hacked as often as once a week, and are thus gradually extended upward until upon trees which have been worked during a number of seasons the upper end of the box may be ten or twelve feet above the ground. Once every few weeks the resin caught in the bottom of the box is removed into a bucket with a small sharp oval steel spade attached to a short wooden handle. The product of these dippings, as this operation is called, is placed in barrels and transported to the distillery. During the first season the boxes are usually dipped eight times, yielding an average of three hundred barrels of turpentine to the crop of ten thousand boxes. The second year the number of dippings is usually reduced to five, the product falling off to one hundred and fifty barrels, while for the third season one hundred barrels are considered a fair yield from three dippings. To this must be added the yield of the scrapings, which for the first year is estimated at from sixty to seventy barrels of two hundred pounds each from a crop, and for the succeeding years at one hundred barrels. The resinous flow is most abundant during July and August, diminishing as the nights become cooler, and ceasing in October or November. Trees are profitably worked in North Carolina during four or five years, and in that state, where the industry has been longest practiced, trees are sometimes worked for more than ten years, and then after a rest of several years are worked again with new boxes cut between the old ones. Farther south the trees seem to possess less recuperative power, and in South Carolina orchards are rarely profitably worked for more than four seasons, while in Georgia, Florida, Alabama, and Mississippi they are frequently abandoned at the end of the second and almost invariably at the end of the third year. The copper stills generally used in this country have a capacity of eight hundred gallons, or a charge of from twenty to twenty-five barrels of crude turpentine, and in order that a still may run night and day trees on about four thousand acres of average Pine land are worked.

The following grades of turpentine are recognized: "Virgin Dip," or "Soft White Gum Turpentine," the product of the first year; "Yellow Dip," the product of the second and succeeding years, growing darker colored and less liquid every year; and

Plants of *Pinus palustris* four or five feet high, cut at the level of the ground, are sold every winter in large numbers in the markets of northern cities for the decoration of churches and living-rooms.[1]

Pinus palustris appears to have been first described by Duhamel in 1755,[2] although the value of its resinous products had been recognized more than a century earlier.[3] By the advice of F. A. Michaux,[4] the French government distributed, about 1830, large quantities of the seeds of this tree

"Scrape" or "Hard Turpentine," the product of the scraping of the boxes. Rosin is graded as follows: "W," window glass; "N," extra pale; "M," pale; "K," low pale; "I," good No. 1; "H," No. 1; "G," low No. 1; "F," good No. 2; "E," No. 2; "D," good strain; "C," strain; "B," common strain; "A," black. Window-glass, which is the highest grade, is produced only from the first dippings of virgin trees; the resinous exudation becomes darker in color and less volatile with every succeeding year, and the rosin darker and less valuable. Trees worked during several years produce dark brown or black rosin. Spirits of turpentine distilled from the resinous exudations of virgin trees is pale-colored, light in weight, and free from any taste; the resinous matter yielded in succeeding years gains more and more body, and the greater heat required in distilling it throws off some resin combined with the spirits, producing a bitter taste and greater weight.

Tar, produced by burning the dead wood and most resinous parts of the Long-leaved Pine in covered kilns, is graded as follows: "Rope Yellow," or rope-makers' tar, — the highest grade, — produced with a minimum of heat from the most resinous parts of the wood; "Roany," or "Ship Smearing," the next running of the kiln; "Black" or "Thin," the lowest grade, made from inferior wood, or the last running of the kiln, and therefore produced with a maximum of heat. (See Flückiger & Hanbury, *Pharmacographia*, 546. — Sargent, *Forest Trees N. Am.* 10*th Census U. S.* ix. 517. — Dunwoody, *Am. Jour. Pharm.* lxii. 284. — Murray, *Am. Jour. Pharm.* lxii. 393. — Ashe, *Bull.* No. 5, *North Carolina Geolog. Surv.* 73 (*The Forests, Forest Lands, and Forest Products of Eastern North Carolina.* — Mohr, *Bull.* No. 13, *Div. Forestry U. S. Dept. Agric.* 67 [*Timber Pines of the Southern U. S.*]. — Bastin & Trimble, *Am. Jour. Pharm.* lxviii. 242, f. 23–27.)

[1] *Garden and Forest*, iii. 12.

[2] *Pinus Americana palustris trifolia, foliis longissimis, Traité des Arbres*, ii. 126.

[3] That the production of tar and turpentine was an occupation of some importance on our southern coast in the seventeenth century appears from the following passage on the fifteenth page of Samuel Clarke's *A True and Faithful Account of the Four Chiefest Plantations of England and America, to wit, Virginia, New England, Bermudas and Barbadoes*, published in London in 1670: "*Pot-ashes*, and *Soap-ashes; Pitch* and *Tar* for making whereof divers Polanders were sent over."

[4] François André Michaux (August 16, 1770–October 3, 1855) was born at Satory, a royal seat near Versailles, and was the only son of André Michaux, famous for his botanical explorations in the Orient, North America, and Madagascar. François accompanied his father to North America, where he was sent to examine its flora and to gather the seeds of trees and other plants for the royal nurseries, and landed in New York on the 1st of October, 1785. He remained with his father, sharing many of his long journeys, until 1790, when he returned to France, and devoted himself to the study of medicine in Paris under Corvisart with the intention of returning to the United States, where he proposed to establish himself as a physician. But the government becoming dissatisfied with the results obtained from the nurseries of young trees which the elder Michaux had left in New Jersey and South Carolina, François Michaux was invited to return to America to ship their contents to France and sell the land. He reached Charleston on the 9th of October, 1801, and remained in the United States until 1803, devoting his time after the fulfillment of his commission to exploring the forests, traveling as far westward as Nashville, Tennessee. Returning to Paris, he published in 1804 his *Voyage à l'Ouest des Monts Alléghanys*, which describes the country he had traversed two years before, and in the following year a *Mémoire sur la Naturalisation des Arbres Forestiers de l'Amérique du Nord*, in which he insisted on the advantages to be derived from naturalizing the most valuable American trees on a large scale in France.

In order to put this idea into operation, he was again sent to the United States, embarking on the 5th of February, 1805, although owing to the capture of his vessel by a British man-of-war he did not reach his destination until the end of May, having in the mean time passed some time at Bermuda. Michaux now remained nearly three years in America, studying the trees of the eastern states, familiarizing himself with their characters and uses, and gathering seeds of the most valuable, from which more than two hundred and fifty thousand plants were raised in France. On his return Michaux began the preparation of the *Histoire des Arbres Forestiers de l'Amérique Septentrionale*, the work by which he is best known. This classical book was published in three volumes, with one hundred and forty-four colored plates engraved on copper. Based on accurate knowledge gained in the forests and workshops of the New World, it is a monument to the energy, patience, and knowledge of its author, and must always be consulted by all students of the trees of eastern North America. The first volume appeared in 1810 when Michaux was forty years of age, the second in 1812, the third in 1813. An English edition in three volumes appeared in Paris and Philadelphia in 1817–19 under the title of *The North American Sylva*, with a few additional plates and some fresh observations by the author. The plates of the illustrations were bought in Paris by Mr. William McClure of Philadelphia and brought to this country, and in 1841, an edition was printed from them at New Harmony, Indiana; another edition appeared in Philadelphia in 1852 with notes by Mr. J. Jay Smith; and in 1865 this edition was republished in Philadelphia with a reprint of the two volumes of Nuttall's *Sylva*. After the publication of his *Histoire des Arbres*, Michaux devoted the remainder of his life to the propagation and cultivation of trees on a small estate of his own and on the grounds of the Société d'Agriculture, to which he was always deeply devoted. In recognition of the hospitality and kindness he had received in the United States, Michaux bequeathed to the American Philosophical Society the sum of fourteen thousand dollars for special purposes connected with the object of his constant ambition, "the progress of agriculture with reference to the propagation of useful forest trees;" and to the Massachusetts Society for the Promotion of Agriculture, of which he was an honorary member, he left the sum of eight thousand dollars for similar purposes.

to land-owners in central and southern France in the expectation that its cultivation on sterile soil would increase the prosperity of the country.[1] It has not, however, flourished in Europe, where only a few of the trees planted at that time survive in southwestern France[2] and in northern Italy.[3]

Invaded from every direction by the axe, a prey to fires which weaken the mature trees, destroy tender saplings and young seedlings, and impoverish the soil,[4] wasted by the pasturage of domestic animals,[5] and destroyed for the doubtful profits of the turpentine industry, the forests of Long-leaved Pines,[6] more valuable in their products and in their easy access than any other Pine forests in the world, appear hopelessly doomed to lose their commercial importance at no distant day.

[1] See *Annales de Fromont*, ii. 308 (*Rapport fait à la Societé Royale et Centrale d'Agriculture*, par F. A. Michaux, *Sur le Pinus australis*). — *Annales de la Societé d'Horticulture de Paris*, 1831, 192. — Soulange-Bodin, *Annales de Fromont*, ii. 381 (*Observations sur la Culture du Pinus australis*); iii. 176 (*Résultat de Semis de Pinus australis*). — *Annales de Fromont*, ii. 377. — Ivoy, *Annales de Fromont*, iv. 284. — Méron, *Rev. Hort.* 1841, 51. (See, also, *Journal d'Horticulture Pratique de Victor Paquet*, i. 280. — Poiteau, *Rev. Hort.* 1843, 109.)

[2] M. L. de Vilmorin, *Garden and Forest*, x. 112, f. 14.

[3] Nicholson, *Garden and Forest*, ii. 567.

[4] Fires, which have long ravaged the forests of Long-leaved Pine, threaten their extermination. Lighted in early spring in all parts of the maritime Pine belt, first by the Indians and then by their white successors to improve the scanty pasturage of the forest floor, they are gradually consuming the fertility of the soil and destroying all seedling Pines and other undergrowth, and seedlings and young plants are now scarce except in regions which have been protected by natural barriers. Fires are especially destructive in the forests which are worked for turpentine, where they are set in spring for the purpose of destroying chips and other combustible matter raked away from the tapped trees to protect the boxes from accidental conflagrations. These fires often spread widely, killing young trees, and stunting the growth of older ones, and burning deeply into the gashes made in the trees of abandoned turpentine orchards, hasten their death or so weaken them that they fall with the first gale. (See Ashe, *Bull.* No. 7, *North Carolina Geolog. Surv.* [*Forest Fires: Their Destructive Work, Causes, and Prevention*].)

[5] Cattle have been turned into the Pine forests of the south since white men inhabited the country; indirectly pasturage has inflicted enormous injury to these forests through fires set in the spring when the Pine seeds are germinating to burn off the old herbage. The direct loss by cattle breaking down young trees and by biting off their tops is also considerable. Hogs, which in the southern states are habitually pastured in the forest, inflict great injury on the Long-leaved Pine forests by devouring the sweet seeds of this tree, of which they are particularly fond, and by digging up the seedlings for their thick succulent tap-roots, which they also find palatable.

[6] *Pinus palustris* is also often called Georgia Pine, Yellow Pine, Hard Pine, and Pitch Pine.

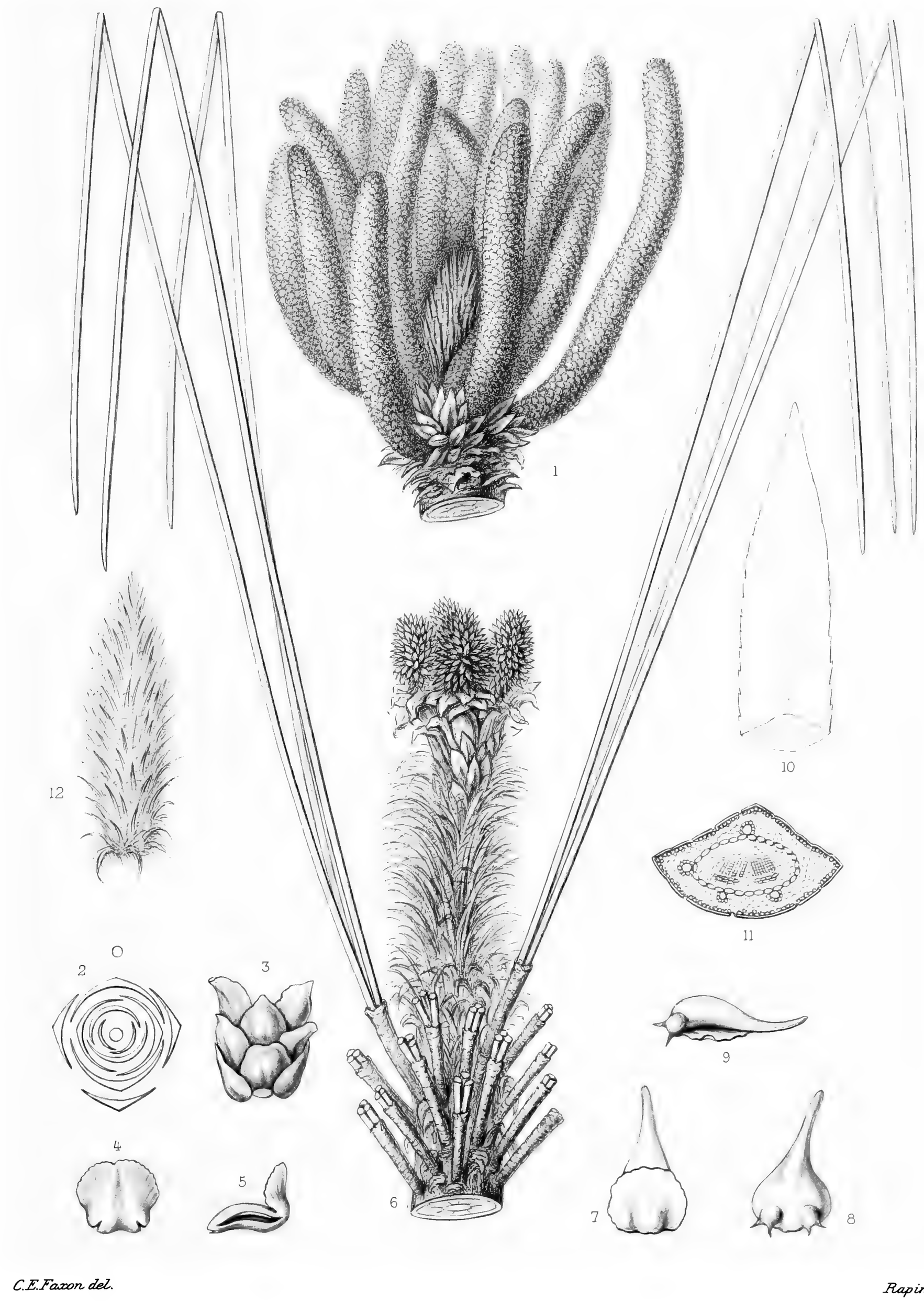
EXPLANATION OF THE PLATES.

PLATE DLXXXIX. PINUS PALUSTRIS.

1. A cluster of staminate flowers, natural size.
2. Diagram of the involucre of the staminate flower.
3. An involucre of a staminate flower, enlarged.
4. An anther, front view, enlarged.
5. An anther, side view, enlarged.
6. An end of a branch with pistillate flowers, natural size.
7. A scale of a pistillate flower, lower side, with its bract, enlarged.
8. A scale of a pistillate flower, upper side, with its ovules, enlarged.
9. A scale of a pistillate flower, side view, enlarged.
10. Tip of a leaf, enlarged.
11. Cross section of a leaf, magnified fifteen diameters.
12. A terminal winter branch-bud, natural size.

PLATE DXC. PINUS PALUSTRIS.

1. A fruiting branch, natural size.
2. A cone one year old, natural size.
3. A cone-scale, lower side, natural size.
4. A seed, natural size.
5. Vertical section of a seed, enlarged.
6. An embryo, enlarged.
7. A seedling plant, natural size.



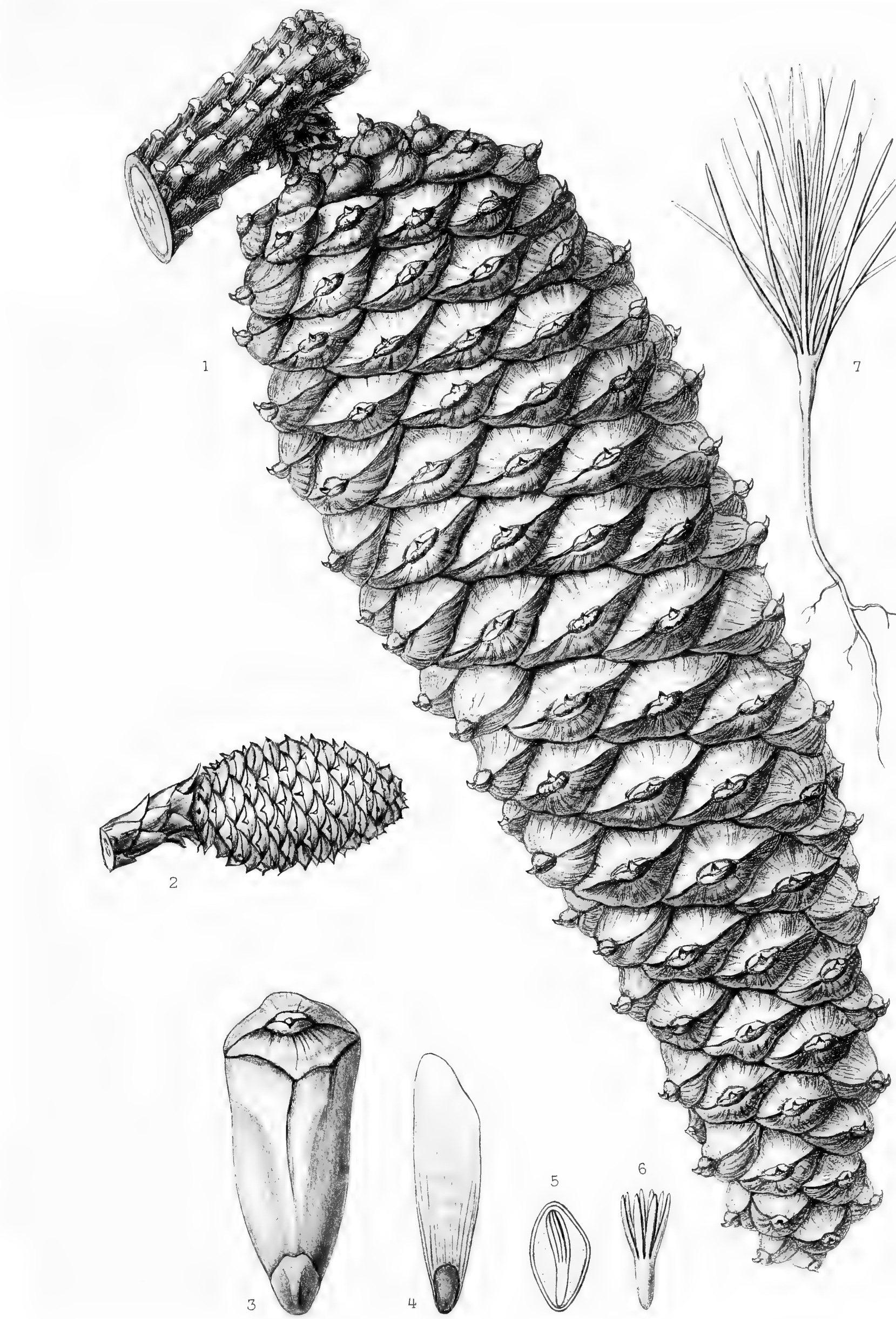
C.E.Faxon del.

Rapine sc.

PINUS PALUSTRIS, Mill.

A. Riocreux direx.t

Imp. J. Taneur, Paris.



C.E.Faxon del. Rapine sc.

PINUS PALUSTRIS, Mi

A.Riocreux direx.t Imp. J.Taneur, Paris.

PINUS HETEROPHYLLA.

Slash Pine. Swamp Pine.

LEAVES in 2 and in 3-leaved clusters, stout, dark green, from 8 to 12 inches in length. Cones ovate or elongated-conical, from 3 to 6½ inches long, their scales armed with short slender prickles.

Pinus heterophylla, Sudworth, *Bull. Torrey Bot. Club*, xx. 45 (1893); *Rep. U. S. Dept. Agric.* 1892, 329. — Mohr, *Bull.* No. 13, *Div. Forestry U. S. Dept. Agric.* 75, t. 9–11 (*The Timber Pines of the Southern U. S.*).

Pinus Tæda, var. **heterophylla**, Elliott, *Sk.* ii. 636 (1824).

Pinus Cubensis, Grisebach, *Mem. Am. Acad.* viii. 530 (1863); *Cat. Pl. Cuba*, 217. — Parlatore, *De Candolle Prodr.* xvi. pt. ii. 396. — Sargent, *Forest Trees N. Am. 10th Census U. S.* ix. 202. — Mayr, *Wald. Nordam.* 115, t, 7, f. — Masters, *Jour. R. Hort. Soc.* xiv. 228.

Pinus Bahamensis, Grisebach, *Fl. Brit. W. Ind.* 503 (1864). — Baker, *Hooker Icon.* xix. t. 1807.

Pinus Cubensis, var. ? **terthrocarpa**, Grisebach, *Cat. Pl. Cuba*, 217 (1866).

Pinus Elliottii, Engelmann, *Trans. St. Louis Acad.* iv. 186, t. 1–3 (1879). — Chapman, *Fl.* ed. 2, Suppl. 650. — Hansen, *Jour. R. Hort. Soc.* xiv. 358 (*Pinetum Danicum*).

A tree, from one hundred to one hundred and fifteen feet in height, with a slightly tapering trunk from two and a half to three feet in diameter and free of branches for sixty or seventy feet above the ground, a comparatively small tap-root furnished with stout lateral roots spreading widely near the surface of the ground, and heavy horizontal branches forming a handsome round-topped head forty or fifty feet across. The bark of the trunk is from three quarters of an inch to an inch and a half in thickness, and is irregularly divided by shallow fissures into broad flat plates separating on the surface into thin dark red-brown scales which in falling disclose the light orange-brown inner bark. The winter branch-buds are cylindrical and gradually narrowed at the apex, the terminal bud being an inch and a half long and a third of an inch thick and much larger than the lateral buds, and are covered by ovate acute light chestnut-brown lustrous scales terminating in slender spreading dark tips and separating on the margins into long slender white filaments which form over the bud a cobweb-like covering thickest near its base; the inner scales, becoming much reflexed, are persistent for at least two years and then fall, leaving their elevated and thickened dark bases to roughen for many years the stout glabrous branches, which, pale orange-color when they appear, are orange-brown during their first winter and then slowly grow darker. The leaves are borne in crowded clusters of two or of three, the two-leaved clusters being most common on young vigorous trees and on fertile branches, with sheaths which at first are thin, close, scarious, pale chestnut-brown below and from half an inch to nearly an inch in length, and which, becoming shorter, and ragged on the margins, fall with the leaves at the end of their second season; the leaves are closely serrulate, acute with short callous tips, dark green and lustrous, stomatiferous with numerous bands of stomata on each face, from eight to twelve inches but usually about nine inches in length and about one sixteenth of an inch in breadth; they contain two fibro-vascular bundles, from four to six internal resin passages, and strengthening cells usually in a single layer under the epidermis and in clusters at the angles of the leaf.[1] The flowers open in January and February some time before the appearance of the new leaves, the staminate in short crowded clusters from the lowest scales of the branch-buds, the pistillate subterminal on stout peduncles from one half of an inch to an inch in length and covered by ovate acute chestnut-brown bracts scarious on the margins, those immediately under the flower being broader than the others, rounded at the apex, spreading, reflexed, and membranaceous. The staminate flowers, which fall as soon as

[1] Coulter & Rose, *Bot. Gazette*, xi. 309.

their pollen has been discharged, are cylindrical, incurved, and from an inch and a half to two inches in length, with dark purple anthers terminating in broad rounded crests denticulate on the margins, and are surrounded by involucres of about twelve concave bracts, those of the lowest pair being not more than half the size of the others and strongly keeled. The pistillate flowers are oval and about half an inch long, with broadly ovate pink scales gradually narrowed into short stout tips and bracts as large as the base of the scales. The cones begin to grow rapidly as soon as the ovules are fertilized, and become horizontal at the end of three or four weeks, when the shoots bearing them, although much lengthened, are still usually leafless; during the autumn they are pendent, about three quarters of an inch long, one third of an inch thick, and light reddish brown; when the flowers open in the following winter they are an inch long and three quarters of an inch thick, with thickened scales armed with stout straight or incurved prickles; and before the end of the following summer they have attained their full size and are ovate or elongated-conical, gradually narrowed to the somewhat obtuse apex, bright green, with dark brown umbos and prickles, short-stalked, pendent, from three to six and a half inches in length and from two to two and a half inches in thickness, with thin flexible flat scales rounded at the apex, their exposed portions, which are conspicuously transversely keeled and slightly thickened, terminating in small transversely flattened umbos armed with minute prickles incurved on the basal scales and recurved on the others; they turn dark rich lustrous brown, the base of the scales being dark dull purple on the lower side and dull mahogany-red on the upper, and, opening and shedding their seeds in the month of October, remain on the branches until the beginning of the following summer. The seeds are almost triangular, full and rounded on the sides, slightly ridged and rough below, and from one sixth to one quarter of an inch long, with a thin brittle dark gray coat mottled with black and an embryo with from six to nine cotyledons; their wings are thin and fragile, dark brown, striate, from three quarters of an inch to an inch long and about one quarter of an inch wide, with nearly parallel sides, their thickened bases inclosing the seeds and often covering a large part of their lower surface.

Pinus heterophylla is distributed from about latitude 33° north in South Carolina southward over the coast plain to the keys of southern Florida and along the Gulf coast to the valley of the Pearl River in Louisiana. It is common on the Bahamas and on several of the West Indian islands, and forms great forests on the highlands of Central America.

In the south Atlantic states *Pinus heterophylla* skirts with scattered groves the shores of the numerous inlets and estuaries,[1] and the adjacent islands, and is mingled with the Long-leaved and Loblolly Pines in the open forests of the littoral Pine flats, ranging inland nearly to the limits of the maritime Pine belt, and in Georgia ascending the valley of the Ocmulgee River a hundred miles from the sea; in Florida, south of Cape Canaveral and Tampa Bay, where it is the only Pine-tree, it crosses the peninsula with pure forests near the coast, and in the interior with small colonies scattered among Live Oaks and other broad-leaved evergreens; and on the shores of the Gulf of Mexico, where it is principally confined to the coast plain, it follows watercourses inland for fifty or sixty miles.[2]

As a timber-tree the Slash Pine, which produces straight sound spars of large dimensions, is little inferior to the Long-leaved Pine, the wood of the two trees being usually manufactured and sold indiscriminately. It is heavy, exceedingly hard, very strong, tough, durable, and coarse-grained; it is rich dark orange-color, with thick often nearly white sapwood, and contains broad resinous bands of small summer cells occupying at least half the width of the annual growth, few and not large resin passages, and many prominent medullary rays. The specific gravity of the absolutely dry wood is 0.7504, a cubic foot weighing 46.76 pounds.

Pinus heterophylla, which is now generally worked for turpentine in the south Atlantic and Gulf

[1] See *Garden and Forest*, v. 73, f. 14.

[2] Mohr, *Bull.* No. 13, *Div. Forestry U. S. Dept. Agric.* 75 (*The Timber Pines of the Southern U. S.*).

states, is rich in resinous products, yielding freely a limpid pale yellow turpentine, less viscid and probably richer in volatile oil than that of the Long-leaved Pine.[1]

Pinus heterophylla was first distinguished in the United States early in the century by Stephen Elliott,[2] who considered it a variety of the Loblolly Pine; overlooked again for half a century, its true characters were finally made known through the observations of Dr. J. H. Mellichamp[3] of South Carolina, although the West Indian tree had been described a few years earlier.

The most beautiful of the Pines of the southern states, the broad compact shapely dark heads of the Slash Pine raised on massive trunks stand out boldly among the more open-headed and less symmetrical Long-leaved and Loblolly Pines, which it seems destined gradually to replace and to become a chief factor in the restoration of the southern pineries. For its seedlings, produced in great numbers every year, are able to thrive without direct sunlight, and, overcoming the more slowly growing seedlings of the other species, sooner attain sufficient size to resist the fires which endanger all young plants in the maritime Pine belt of the south.[4]

[1] Mohr, *Bull.* No. 13, *Div. Forestry U. S. Dept. Agric.* 76 (*The Timber Pines of the Southern U. S.*).

[2] Stephen Elliott (November 11, 1771–March 28, 1830) was a direct descendant of William Elliott, a leading merchant of Charleston, who arrived from England in 1670, and on the maternal side a great grandson of John Barnville. He was born in Gifford, South Carolina, was graduated from Yale College at the age of twenty, and studied medicine, although he never practiced the profession. In 1793 he was elected a member of the legislature of South Carolina, continuing to represent his district until 1812, when he was chosen president of the New State Bank of South Carolina, a position which he filled until his death. In 1813 Mr. Elliott took an active part in establishing the Philosophical Society of South Carolina, of which he was the president. He was a constant contributor and probably the real editor of the *Southern Review;* and in 1825, on the organization of the Medical College of South Carolina, he was appointed professor of natural history and botany in that institution. Interested from boyhood in literary and scientific studies, Mr. Elliott devoted particular attention to the plants of his native state, the result of these observations being published in his *Sketch of the Botany of South Carolina and Georgia*, a classical work upon which his reputation as a man of science now rests. It appeared in parts in two volumes, between 1816 and 1824, and contains accurate descriptions in Latin and English of the plants of the region, with numerous observations upon their medicinal properties furnished by Dr. Thomas McBride. Mr. Elliott's herbarium is preserved in the Charleston Museum.

The name of Stephen Elliott is also preserved by *Elliottia*, a genus of plants of the Heath family of his discovery, which was established by Muehlenberg and consists of three shrubs, the type being one of the rarest of North American plants, and the others common inhabitants of the forests of northern Japan. (See *Garden and Forest*, vii. 204, f. 36, for portrait of Stephen Elliott.)

[3] See viii. 144.

[4] Germinating easily, the seedlings appear in great numbers from early spring to the beginning of summer in old fields and in openings of the forest wherever the rays of the sun can reach the ground. As soon as the cotyledons have expanded, the terminal bud develops quickly and the first internode of the stem, lengthening rapidly, is covered with soft linear acute primary leaves about an inch long. Before the end of the second month clusters of the foliage leaves make their appearance in the axils of some of the primary leaves, and at the end of the first season the young plants are from eight to nine inches high, with slender tap-roots and many lateral rootlets. At the end of their second year they are from twelve to fifteen inches in height, with slender tap-roots not more than four inches in length, and at the end of their third year they are often nearly two feet high, with lateral branches developed in regular whorls. Trees from ten to twelve years of age measure from ten to eighteen feet in height, with stems clear for half their length and from two to four inches in diameter. Trees from eighteen to twenty years old are from forty to fifty feet high, with stems eight or ten inches in diameter at the ground. Second-growth trees examined by Dr. Mohr near Mobile, forming open groves on soil deficient in drainage, were found to vary from sixty-five to eighty-five feet in height, and from fifteen to twenty inches in diameter breast-high, while trees of second-growth sprung up on better drained soil, with free exposure to sunlight and air, reach their full size in half the time required by trees growing naturally in forest-covered swamps.

From Dr. Mohr's observations it appears that the greatest mass of wood for any decade is formed by this species when the trees are about fifty years old, the annual growth and volume being nearly fifteen cubic feet for the preceding ten years, that at the age of ninety the growth and volume are only about two thirds of the maximum; and that when the trees are one hundred years old the average annual growth nearly equals the current growth, indicating that they are then ripe for the axe as far as probable development, represented in volume accretion, is concerned. (See Mohr, *l. c.* 81.)

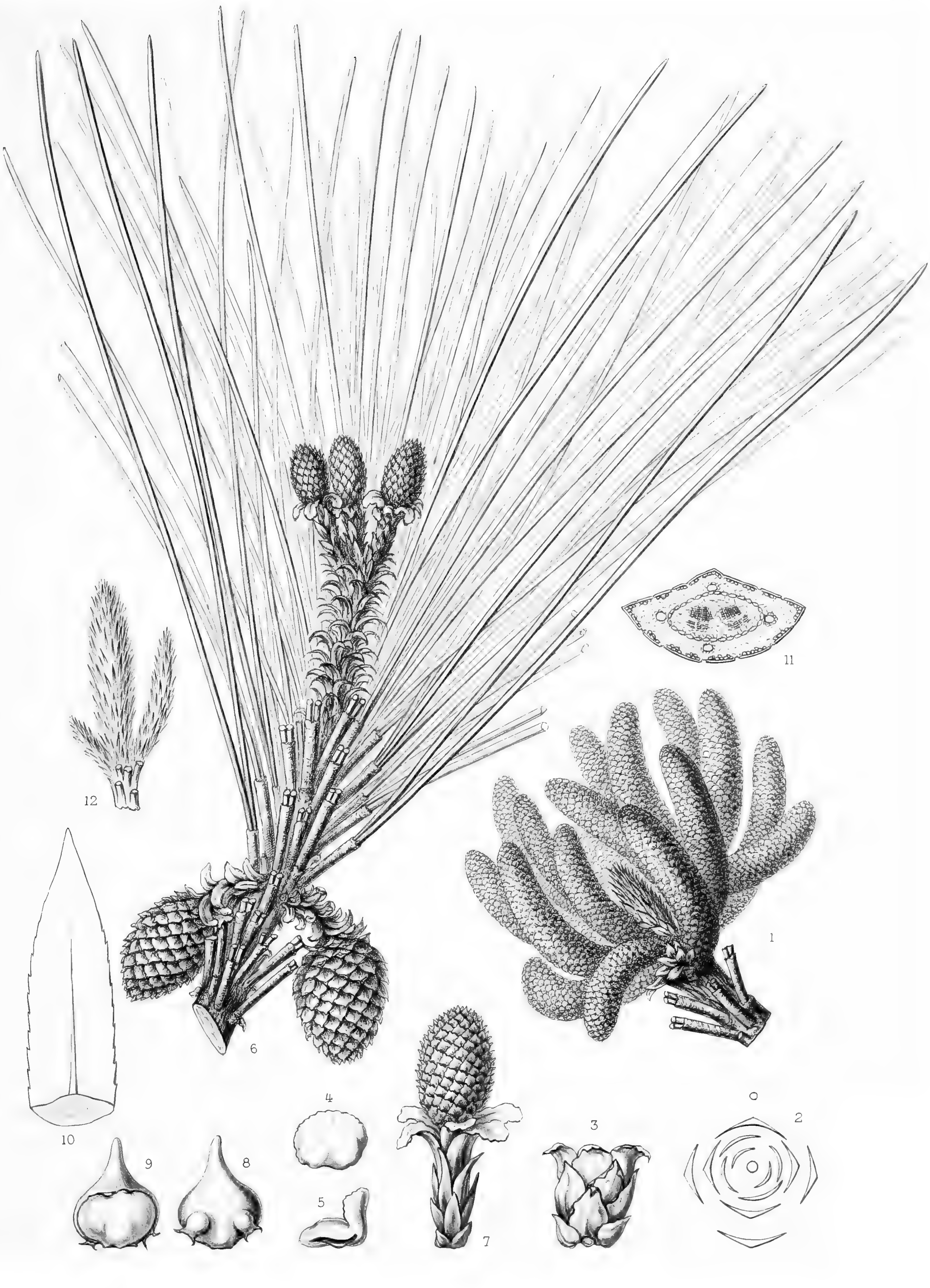
EXPLANATION OF THE PLATES.

Plate DXCI. Pinus heterophylla.

1. A cluster of staminate flowers, natural size.
2. Diagram of the involucre of the staminate flower.
3. An involucre of a staminate flower, enlarged.
4. An anther, front view, enlarged.
5. An anther, side view, enlarged.
6. A branch with pistillate flowers and yearling cones, natural size.
7. A pistillate flower, enlarged.
8. A scale of a pistillate flower, upper side, with its ovules, enlarged.
9. A scale of a pistillate flower, lower side, with its bract, enlarged.
10. Tip of a leaf, enlarged.
11. Cross section of a leaf, magnified fifteen diameters.
12. Winter branch-buds, natural size.

Plate DXCII. Pinus heterophylla.

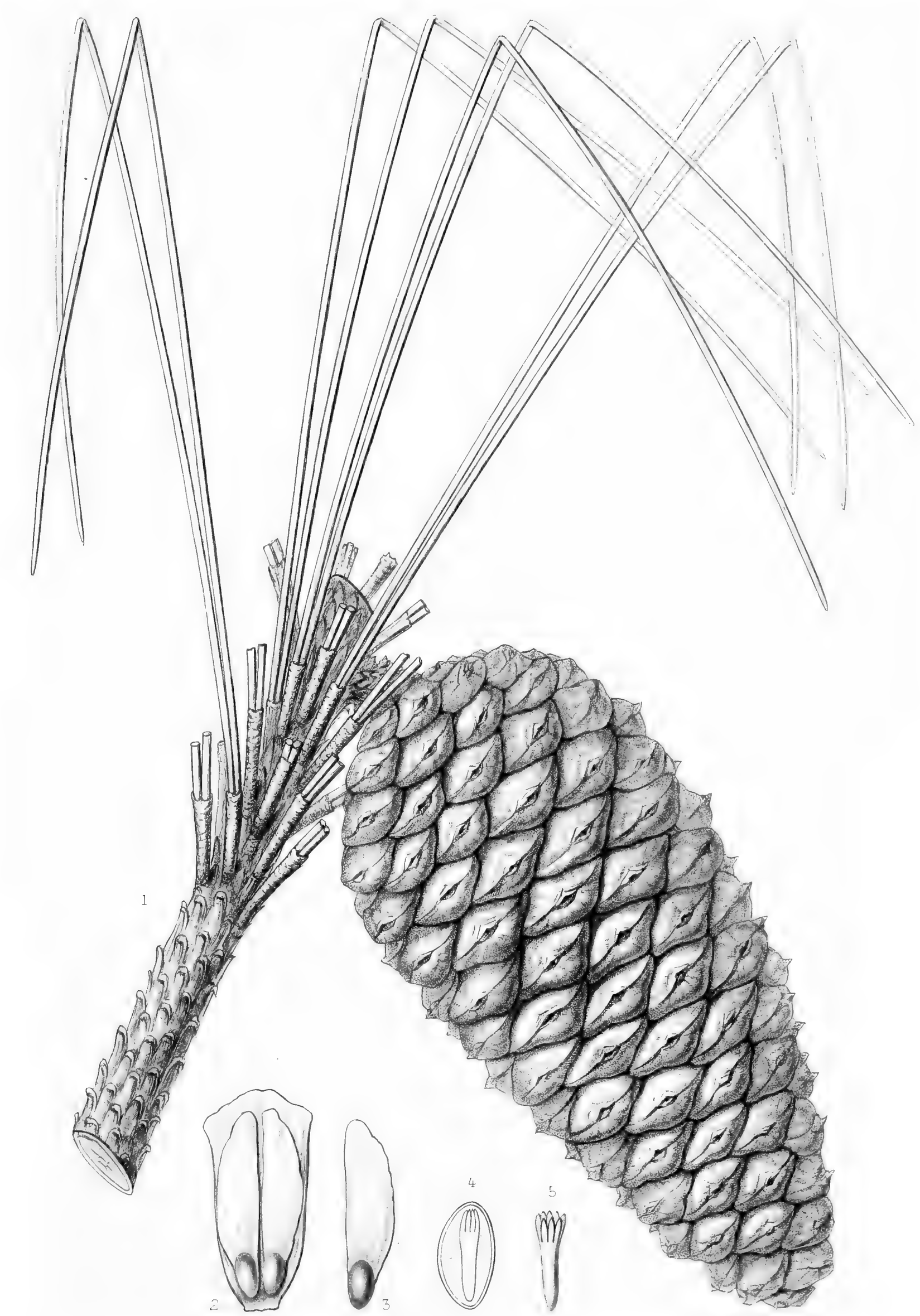
1. A fruiting branch, natural size.
2. A cone-scale, upper side, with its seeds, natural size.
3. A seed, natural size.
4. Vertical section of a seed, enlarged.
5. An embryo, enlarged.



C.E. Faxon del. *Rapine sc.*

PINUS HETEROPHYLLA, Sudw.

A. Riocreux direx.t *Imp. J. Taneur, Paris.*



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PINUS HETEROPHYLLA, Sudw.

A. Riocreux direx.t *Imp. J. Taneur, Paris.*

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